Developing a persona-based user-centred design model in relation to idea generation that will both manage the product design processes and solve design problems

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Abstract

User-Centred Design (UCD) was proposed in the 1980s and, since then, its philosophy has helped to solve design problems, regardless of the advances in technology over time. The standard ISO 9241:210 (2010), formerly ISO 13407, provides guidance in human-centred design principles and activities undertaken throughout the design lifecycle to further support UCD. In addition, since it was mentioned in ISO 9241:210, UCD has also utilised User Experience Design (UXD) in recent years. There are many approaches that support UCD to ensure it is more attainable when designing. In addition, large firms, such as HP, IBM and Microsoft, use anthropologists in their user research in order to make products more user-centred. However, the concept of UCD should, theoretically, be more widely used in all product design and it is intriguing as to why it is not as popular as it should be. As noticed in the real world, imperfect designs still frustrate us everywhere.

The aims of this thesis were to investigate the difficulties of practicing a UCD approach in idea generation and to design solutions for idea generation that would encourage further practice of UCD/UXD. In the first part of the thesis, there is an exploration of the problems encountered when practicing UCD idea generation. When examining the process, a multitude of problems were found, with most blamed as being costly, time consuming and requiring complex skills. In addition, it was suggested that a systematic solution was required to overcome such difficulties. Therefore, later in this research, a systematic model is proposed and evaluated using participants (both designers and target users). Due to the fact that design practitioners are not usually researchers, further help to implement the model in the form of persona application software is needed. Hence, the concept of service design was employed to further assist with the use of the model. In the end, computer-aided development was introduced, together with the integration of the systematic UCD model. The UCD model and the software have been evaluated as effective from both the responses of product design practitioners and end-users.

Future recommendations and the research limitations are also discussed in each chapter and the overall results are given in the last chapter. This thesis successfully provided the complete process during the exploration of the low usage problems of UCD, and solutions were presented to assist designers with their UCD/UXD in the future.

Keyword: User-centred design, user-experience, personas, empathic design, design practitioners, CAD and service design.

Acknowledgments

This is the first time, I have felt so self-motivated to undertake a research, and I never realised I would become so involved with this research. Consequently, I need to acknowledge many people who accompanied me during this research journey.

I would like to thank my first supervisor, Dr. Robert C.C Chen. I could not have entered this design field without his encouragement and advice, given both academically and personally. He gave me the confidence to carry out my work independently and to become a real researcher. In addition, his enthusiastic attitude toward his students also influenced me.

Mr. Nick Higgett, my second supervisor, always listens patiently and gives suggestions to improve my research. Additionally, Professor Ho Ming Chung greatly inspired me to enter the UCD area. His knowledge of design philosophy gave me many research leads which helped to speed up the literature study.

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1. Introduction

1.1. Background and motivation

As humans, we use products and interact with them all the time. Some of them are favoured by us and some of them frustrate us. With technologies that evolve rapidly, it is feasible that more and more problems from improper design will occur. Consequently, user-centred design (UCD) was proposed for these circumstances.

User-centred design is the philosophy that says the design should consider users and satisfy the user's need (Norman, 1990) and many approaches have been suggested in order to make UCD achievable. UCD evolves when technologies improve, and to satisfy users, it is not simply necessary to design functions correctly but to also be concerned with the user's emotional satisfaction. Norman, in his later book "Emotional Design: Why We Love or Hate Everyday Things" (Norman, 2004), argued his previous viewpoint regarding this, using an emotional design supplement to explain UCD. The evolutionary trace of UCD can also be seen from the ISO standard. In 1999, ISO 13407 defined and gave guidelines for human-centred design. In later years, ISO 13407 became ISO 9241:210(2010), and was given a new name, user experience. User experience design (UXD) is currently in use most of the time.

Even though UCD is recognised as useful in most product design practices, it has also attracted critics. These have highlighted issues of the inappropriate use of UCD methods and the misunderstanding that 'UCD is everything to successful design'.

The approaches, namely participatory design (PD), contextual design (CD) and empathic design (ED), are mostly recognised as UCD approaches. These approaches offer a system viewpoint that covers the complete UCD process. The main characteristic of PD is the role of the user. The users are given the same consideration as the designers in the democratic structure. Under the structure, the users' voices are the most valued input. However, this process needs a high level of technique by the moderator to arbitrate the contradiction. Alternatively, CD emphasises observation in the context of the interaction process between users

and the design, and the challenge is the exploration skills needed by the users during those interaction experiments. The main concept of ED focuses on the observation and experience of the users in order to earn their empathy, which means that designers should understand the users to be able to implement the design. Technically, CD is a more flexible way and, consequently, fits a wider range of designers, for instance, new designers, senior designers, designers working for larger enterprises, designers in small firms, long design lifecycles or rapid design lifecycles, etc.

A newer approach is the use of personas. Personas are a UCD skill. Since Pruitt and Adlin (2002), the use of personas has formed a complete approach. In their later book, 'Why Personas Work – the psychological evidence' (Pruitt and Adlin, 2006), they provide detailed discussions from a persona's birth to details that cover the whole product lifecycle.

It can, therefore, be seen that UCD has existed for a long time and that there is a complete structure of approaches and guidelines to support it (Figure 1). We can regard this as the evidence that UCD is a very important design paradigm. However, although the approaches have evolved to fit the time period, improper designs still fill our daily lives. This raises questions for research to find out why this is the case and this has become one of the aims of this thesis.

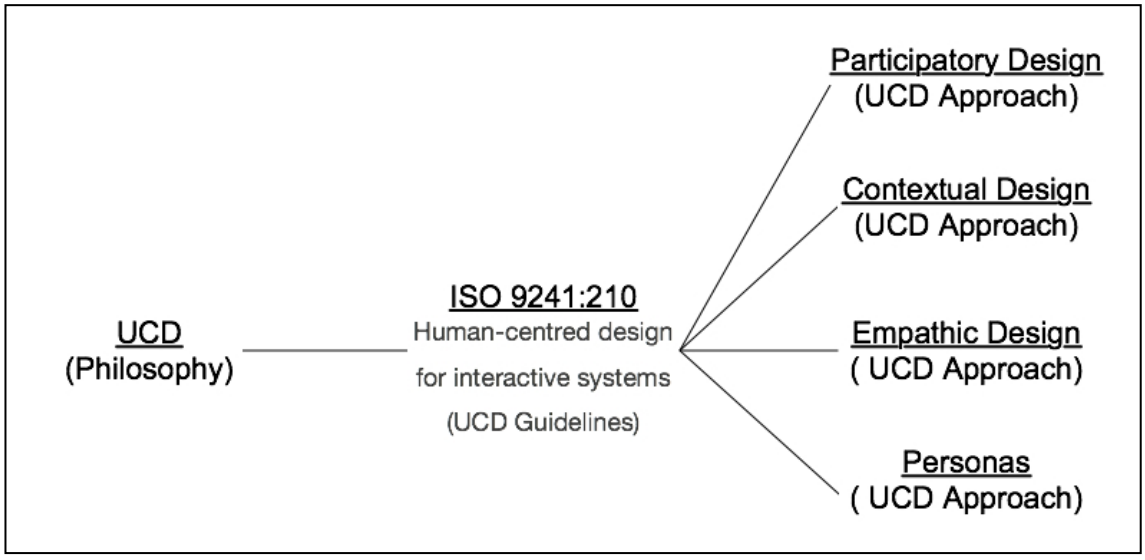


Figure 1 The structure of UCD

There are many products designed with bad usability. Figure 2 is a typical example

of bad usability because it is difficult to find the correct switch to control the cooker ring. However, Figure 3 shows how it can be done properly.

Figure 2 The cooker and the switches (bad design).

Figure 3 The cooker and the switches (good design)

The general definition of UCD is to consider users and to satisfy a user's need. However, badly designed products fill our lives and this means there are many products that dissatisfy the users, which means they are not qualified with UCD. Therefore, the main motivation of this research was to discover the current UCD usages, and the reasons that prevent UCD design from being more popular. In particular, our assumption is very clear that UCD is worth considering and is the right way for designers to design. In addition to investigating the obstacles of UCD usage, it was also interesting to provide some solutions and, hopefully, to increase the use of UCD.

Product design is a wide area, and designers carry a mission to initiate the product

scope. Therefore, there is motivation to observe the designer practitioners' design activities with regard to idea generation, since the generation of an idea is the birth of the product. The aims, objectives and the research framework, therefore, are explored in the following sections. Figure 4 is the thesis structure and illustrates the scope and index for this study.

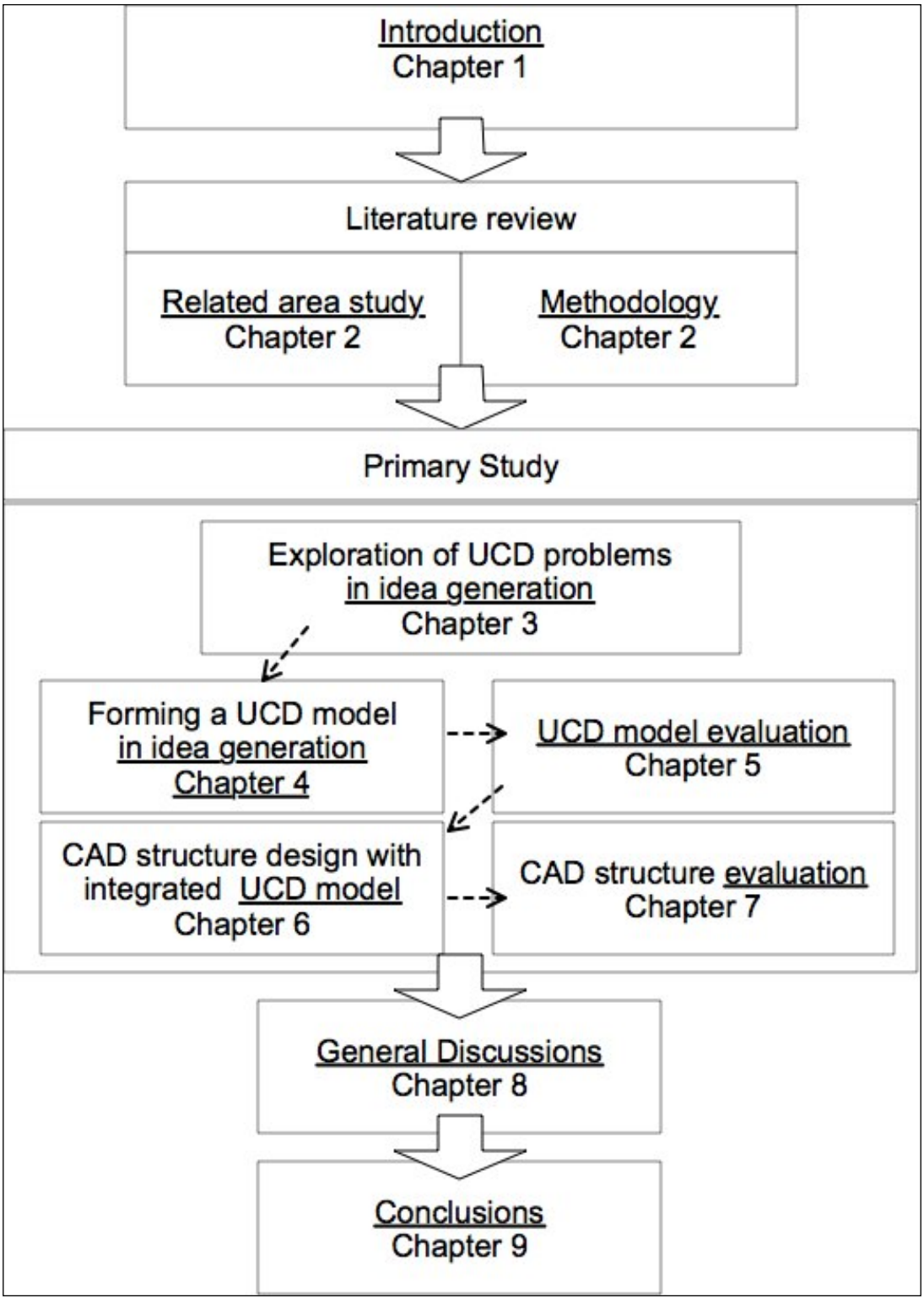


Figure 4 Thesis framework

1.2. Aims and objectives

The main aims of this thesis are to analyse the difficulties of UCD idea generation

and to propose a solution that will encourage the generation of more UCD ideas.

In order to achieve the aims of this thesis, there are many objectives defined below, and these objectives form the basis of the primary studies discussed in Chapters 3 to 7.

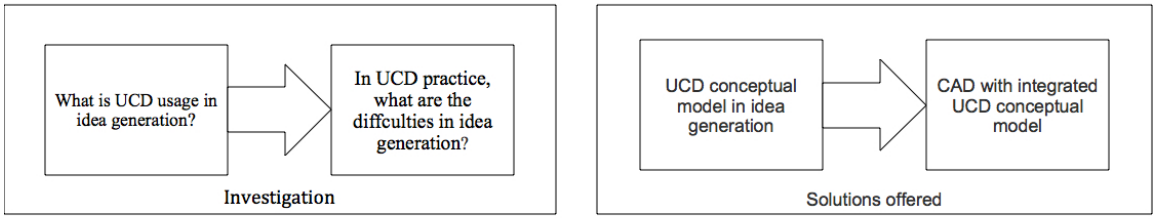


Figure 5 Research aims

List of objectives:

1. To document the current UCD design status of idea generation in order to discover the difficulties and why designers do not use user-centred approaches (see chapter 3).
2. To create a design process evaluation task for product designers in order to construct a UCD model for idea generation (see chapter 4).
3. To design an evaluation for product designers and the target end users in order to assess the UCD model for UCD idea generation (see chapter 5).
4. To design a framework for application software that could provide assistance when using the proposed UCD model (see chapter 6).
5. To assess the framework of the application software for UCD product with product designers in order to collect suggestions for detailed software implementation (see chapter 7).

1.3. Methodology

Literature review

This research consists of the following keywords: user-centred design, user-experience, personas, empathic design, design practitioners, CAD and service design. The literature study provided the rationales for this research in order to produce the research aims, objectives and methodologies.

UCD is the main theory supporting this whole research and it is critical to understand that the concept, evolution and available approaches were important. In particular, UCD has a long history and the concept has evolved over time to fit its essential spirit, which is to 'satisfy the user's need'. In addition, ISO standard 9241:210 was introduced to explain the terminology used in UCD, the UCD design process, and to offer guidelines when approaching UCD. UCD appeared as user experience design (UXD) after ISO standard 9241:210 was published.

The following approaches were also reviewed in order to ascertain the best solution for the needs of this research: participatory design, contextual design, empathic design and personas. All of them provide a detailed process that can guide UCD. However, some genetic problems were found and which can become challenges in the design work, such as limited budgets, limited time and manipulation skills.

Service design is user-centred thinking, and defines the design objects as being activity-based. This concept has been used to develop this thesis and, therefore, the scope of the service design is discussed. In addition, CAD (computer-aided design) has been used to engage design with manufacturing since the 1960s. The detailed literature review is discussed in Chapter 2.

In order to construct the methodology for this research, many qualitative research skills and UCD methods for the assessments were also reviewed, including interviews, observations, contextual inquiries and card-sorting. Detailed discussions about the methods and methodology design are also featured in Chapter 2.

Primary study

To accomplish this research, there were many assessments designed to prove the hypotheses in this research. In addition, it was necessary to consider the resources

that were available and their efficiency. Therefore, a mixture of UCD methods was used to carry out this research, even though there are many pathways using different combinations of the various methods. Some of the research methods are, however, similar to all other research of this kind.
The methods used to gather the information were:

- Observations (Chapter 3, Chapter 4, Chapter 5)
- Semi-structured Interviews (Chapter 3, Chapter 4, Chapter 7)
- Think-aloud Protocol (Chapter 3, Chapter 4, Chapter 7)
- Contextual inquiries (Chapter 3, Chapter 4, Chapter 7)
- Questionnaires (Chapter 5)
- Card-Sorting (Chapter 7)

The methods used for analysing the results were:

- NVivo (Chapter 4, Chapter 4, Chapter 7
- Pair T-Test in SPSS (Chapter 5)

The research can be grouped into two sections, namely an exploration of the problems, and the solutions. The assessments are from Chapters 3 to 7, and the cross-chapter discussions are featured in Chapter 8.

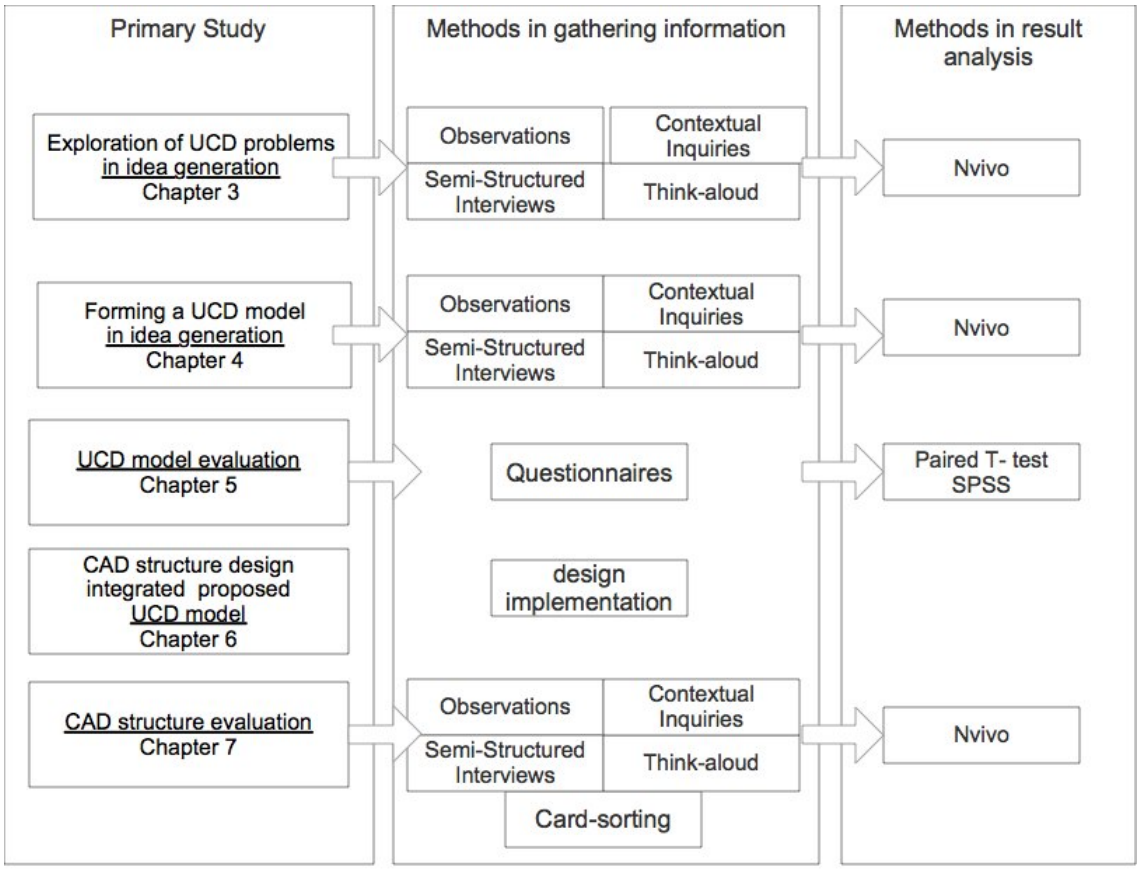


Figure 6 Methods used in the primary study

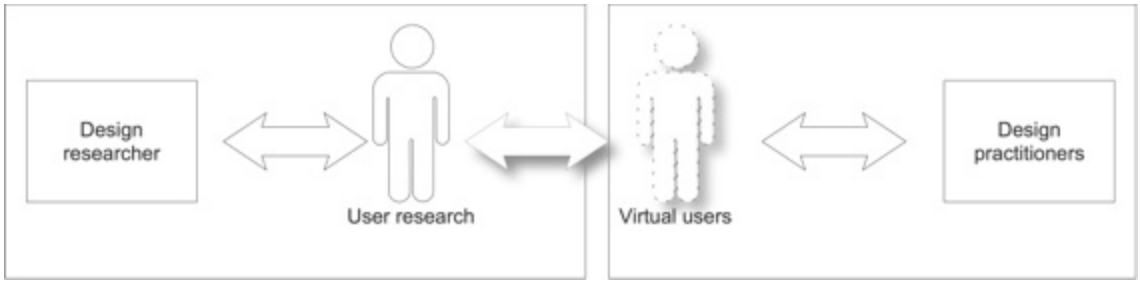
Chapter 3 is an exploration into identifying the difficulties of practicing UCD in idea generation. When exploring the problems, the aim was to find out what prevented UCD being used for idea generation? Sensing that UCD is not as popular as it should be, this is the correct way to proceed. Is it because designers are using UCD incorrectly? Or do designers not follow UCD? Therefore, in Chapter 4, a process was designed to answer those questions. There were 20 participants who took part in this assessment, for which interviews, think-aloud protocol, contextual inquiries and observations were carried out in order to gather the information.

The results were processed and transcribed with the help of NVivo and answers were found to the questions above. The designers were either not taking part in UCD or they were doing UCD incorrectly. In addition, all of the participants were design practitioners, which might suggest that design practitioners have different views or background knowledge from other design researchers and, therefore, UCD is not as popular. Furthermore, in the whole process, it can be seen that design practitioners use several methods of their own to generate ideas. However,

none of the systematic methods guide them to UCD idea generation easily. There are also problems of distraction found in their current design activities.

Chapter 4 concentrates on developing a persona-based UCD model for idea generation: After the problems were identified in more detail, design solutions were introduced to increase more UCD idea generation. In Chapter 5, the proposed concept was used to form a process type model to tackle the problems found in Chapter 4, as Figure 7 shows (personas together with empathic design).

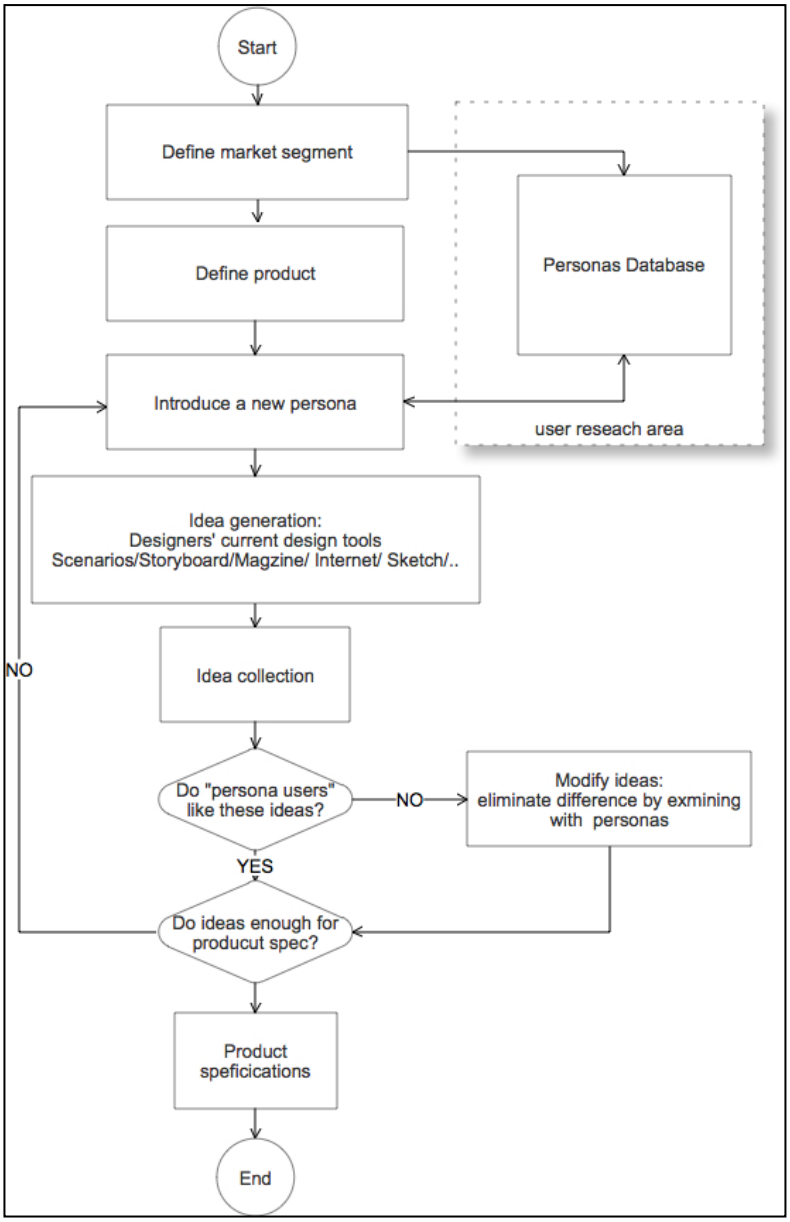
The strength of the proposed concept for constructing the UCD model is in dividing the job between the design research work and the design practice. Additionally, by engaging personas, an easier concept for the design practice is achieved as fewer skills are required due to the fact that no real users are involved. As previously pointed out, real user involvement is costly, time consuming and complex in operation (Abras, Maloney-Krichmar and Preece, 2004).



7 Proposed concept of model

The tasks were a continuous assessment, as discussed in Chapter 4. Additionally, similar methods were employed to conclude the UCD model. In the process, 20 participants were invited to take part. Even though the participants had little knowledge about the main body of the UCD model (personas and empathic design), the results achieved were very successful. In order to ease the learning load, one of the features of this model is to ask them to design in their own way but using the UCD model sequence as advised. As well as a review of the participants' ideas, the design experts were also asked to review the UCD model that was provided. One imperfection was found in the model: the more personas introduced, the more the ideas were reduced due to compromises between the different types of user. The involvement of more users will bring either more different aspects of consideration or the confliction of ideas produced previously. Therefore, a check

was added to enable a review in order to see if the ideas were good enough for the next step: making a product specification.



8 Proposed UCD model using personas as the basis

Chapter 5 features the validation process required for a persona-based UCD model and a different review for this model was arranged, which used an evaluation of the proposed UCD model from the end user's side. It can be seen that the ideas generated by the model seem to have a pattern or tendency of design. However, some ideas are without any traceable pattern to support them, whether they are UCD or not. Therefore, the ideas were divided into two pairs: their own design (i.e. non UCD or in a less UCD way) and a UCD design. Following this, 16 sets of

design ideas were defined for the 51 end-users who are located in the task, namely female workers aged 25-34. The results were gathered from the questionnaires, and a paired-T test was used to analyse these results. The results showed that the ideas generated by the proposed UCD model were preferred by the end users.

Chapter 6 discusses structuring a UCD idea generation CAD. Even though a UCD model for idea generation was successfully built, there were still two challenges. Firstly, design practitioners do not know the tips for using personas and empathic design. As mentioned, design practitioners are not researchers and, therefore, it is not easy for them to use this model. This will decrease their willingness to use the model or use it incorrectly, such as setting up the photos, names, profiles or even the number of personas. Secondly, the creation of personas seems to be a big challenge for the designers. It is proposed that CAD is used by the design researcher for this job. In this chapter, the CAD plan is initiated and, hopefully, the skills will be embedded seamlessly to make the operation easier. The CAD is a web-based structure with a persona database.

Chapter 7 evaluates the CAD specification for UCD idea generation based on the personas. 13 design practitioners were invited to be the users in order to evaluate the CAD structure developed earlier in chapter 6. Card-sorting skills were selected to interact with the participants, together with a think-aloud protocol and contextual inquiries. Participants, mostly, had no previous knowledge of personas and, therefore, they expected to have a tutorial and help to assist with their use. Consequently, a built example might enable them to see and modify their own project. It was noticed that the different backgrounds of the individual design practitioners provided different depth and detail for the CAD structure. However, the pattern of the requested functions was quite similar.

Chapter 8 features a general discussion. Although discussions have previously taken place in each chapter, in chapter 9, discussions continue on the topics below:

- Why is UCD idea generation difficult?
- Is UCD going to kill creativity?
- Empathic design, personas and the proposed UCD model.

- Whom does the UCD model benefit in idea generation?
- Differentiation of personas used in this UCD model from other research.
- Is the proposed UCD model helping UCD idea generation?
- Building the structure of the personas application software.

1.4. Related works

This study provided a complete context, from an exploration of the problems when practicing UCD idea generation, to the solutions. There are no directly related works to this study. Therefore, the thesis is divided into several sections, and similar works are argued in this section.

This study was initiated from a curiosity about UCD problems, and was later confined to idea generation. Similar approaches are discussed in Chapter 2. Participatory design, contextual design and empathic design provide a complete pathway through the UCD design process, but, due to the nature of the user involvement, the approaches are mostly executed by bigger companies, such as HP and IBM (Chen et al., 2009). Empathic design starts from understanding the users. However, it does not mention the position of the users. It has been noted that the difficulties encountered in the majority of UCD approaches are mostly due to the involvement of users. Personas have common ground with empathic design; both of them are UCD approaches but neither of them highlights the real-user involvement. Therefore, personas have the closest theory regarding this viewpoint.

Since Alan Cooper first promoted personas in his book, 'The Inmates are Running the Asylum' (Cooper, 2004), personas have been widely used in the computer science domain. Personas provide user profiles that represent a group of people. The two main benefits of the use of personas are for communication between teams and to help designers focus more on their users (Grudin and Pruitt, 2002). Microsoft has researched further findings, in terms of the use of personas. In their work, they use personas to develop their popular software, such as 'Office' and 'Messenger', finding that the use of personas is of great benefit to design tasks. In addition, famous Japanese businesses are using them for organization communication.

Many articles provide the manuals for the creation of personas, such as the works of Grudin (2006) and Olsen (2004). These researches have pointed out one important thing; that the personas should be supported by real user data. Nevertheless, creating believable and reliable personas needs proper education. Consequently, this is a key weakness in the promotion of the use of personas.

During this research, the author used personas as the key technique and, inheriting many of the advantages from work previous to this research, investigated how personas can help a designer to develop a product concept in their individual work. In other words, this research will not concentrate on the communication between teams, one of the biggest beneficial functions. Instead, this research will analyse the aspects that the individual designer can use to connect with UCD.

Hosono et al. (2009) proposed a CAD model for service design, and personas were chosen as the method in their research. This CAD model mainly focused on building the relationships between all the stakeholders by the use of personas. However, it did not tell readers how to make personas or how to use them in their work.

Marcengo (2009) proposed a persona-CAD model that promotes a similar benefit to this research, the reuse of the personas. It divided the persona-CAD into two sections: one is a reusable layer and the other is a non-reusable layer. This research does not argue their points, but is mainly focused on the reusable concept by giving the technical details of how to make personas reusable, which is one of the important points of this research.

1.5. Research limitation

The research limitation is discussed from three sides: task assignment, the selection of participants and the CAD implementation. Regarding the task design, the task has to be the same in order to analyse the differences9 between the participants and to observe the context. Therefore, participants from different areas may have different design performances.

Due to the nature of this study, participants were only targeted if they had design practice experience. Therefore, there were certain limitations for further study, such

as participants' design expertise (e.g. fashion, multimedia design, etc.).

Technology today changes rapidly and mobile devices have dramatically changed user behaviour. In addition, there is a political issue; it was claimed that Flash CS3 was not to be supported by Apple Inc. These changes had a huge impact and raised uncertainty for the implementation of CAD. Therefore, in this research, the CAD structure was designed to be integrated with the UCD model, instead of real software coding.

1.6. Research outcome

The main contribution of this research is to analyse the whole scope of the problem-solving process, from exploration to identifying the problems in practicing UCD idea generation. A CAD was suggested together with an integrated UCD model in order to encourage and improve further UCD work.

The research outcomes included:

1. Problems found in UCD idea generation from design practitioners.
2. Development of a persona-based UCD model for idea generation as the solution to encourage more UCD practice.
3. CAD guidelines that implement a UCD model for idea generation.

Future recommendations.

2. Literature Review

2.1. Introduction

In this chapter, the background knowledge to support this thesis is discussed. This research is confined to ‘user-centred design’, ‘personas’, ‘idea generation’ and ‘service design’. Consequently, the literature review will focus on these main topics.

This research aims to provide suggestions to designers in their individual design work towards UCD idea generation. Therefore, although user-centred design (UCD) has a wide scope and can be used throughout the whole design process, this research only discusses the front-end collection of requirements, as these are the most important roles for a designer.

UCD is the main theory used to support this research and understanding its concept, evolution and the available approaches is important. UCD has a long history and, therefore, the concept has evolved across time to fit its essential spirit of ‘satisfying the user’s need’. In addition, ISO standard 9241:210 was introduced to explain the terminologies used in UCD, define the UCD design process, and give guidelines for approaching UCD. UCD is now also known as user experience design (UXD) after ISO standard 9241:210 was published.

There are many conventional approaches to UCD, for instance, participatory design, contextual design and empathic design. All of them provide a detailed process that can guide designers to design a UCD. However, some generic problems can be found and these become challenges for the design work. Empathic design is the closest to UCD and is more likely to be used if there are no cost concerns since its main idea is for the designer to understand the users. To understand the end-users is a concept. It is necessary to use it flexibly, such as using it with another method when there are budget concerns; the main priority is to satisfy the idea of ‘understanding the users’.

Personas are popularly discussed as a UCD/UXD design tool, especially in the early stages of a design. In this research, personas were chosen as a tool to achieve the main research objectives and it is necessary to introduce the story of personas in relation to this research. Therefore, a review was undertaken of the

origin of the personas from Cooper's book (2003) and then the psychological evidence of why they work in design is also mentioned. Cooper gave an introduction to personas. However, the most complete introduction is from Pruitt and Adlin's book, published in 2006. The book provides rich information of case studies, as well as a proposed model that uses personas in the whole design process. In this thesis, the knowledge behind persona creation was adapted, as well as the use of personas, as the basis to understand this research..

Service design is user-centred thinking, and defines the design objects as activity-based. Regardless of whether the design object is tangible or intangible, all agents that are linked with the users should be considered during the design process to improve the user experience. This concept has been used to develop this thesis and, therefore, the scope of the service design is discussed. In addition, CAD (computer-aided design) has been used to engage with design and manufacturing since 1960. The technology has largely evolved, but this was not the research interest in this study. Therefore, there is only a brief discussion to show readers the benefits of CAD.

The purpose of this chapter is to build a common ground for this research by allowing a better clarification of the assumptions, assessments and arguments in relation to this research.

2.2. Idea generation

New product development (NPD) is a multi-discipline activity linked with marketing, design and manufacturing (Ulrich and Eppinger, 2012). The specific details and process may vary across different industries. However, a general product process can be described, as in the following figure (Figure 9).

The process can be further broken down into smaller steps. In phase 0 of Figure 9, it can be seen to involve a series of marketing activities. Marketing is a different aspect that uses complexity from the design, although they are linked tightly from the view point of the production development process. Since marketing activities are from a different profession, and involve many plans, the opportunity for evaluation and decisions are made by those at managerial level and marketing personnel instead of designers. Therefore, this research is confined after the

design target is defined. In other words, this research takes place after phase zero when the designers' activities usually start.

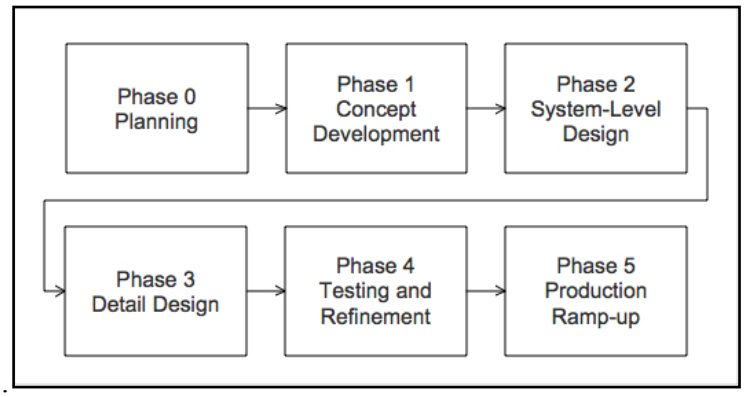


Figure 9 Product development process (Revised from Ulrich, K. T. and Eppinger, S. D., 2012, p9)

Phase 1 concentrates on the concept development, usually called the 'front-end process'. At this stage, the needs of the target are already defined. There are a series of activities that are suggested before the next practical design stage. However, this thesis only focuses on the discussion of the "fuzzy front end".

Fuzzy front end (FFE) is the stage between market segmentation and the product specification (Figure 10). It is defined by those activities that come before the more formal and well-structured NPD process. In addition, fuzzy front end is thought as one of the greatest opportunities for improvement of the overall innovation process (Koen, et al., 2002).

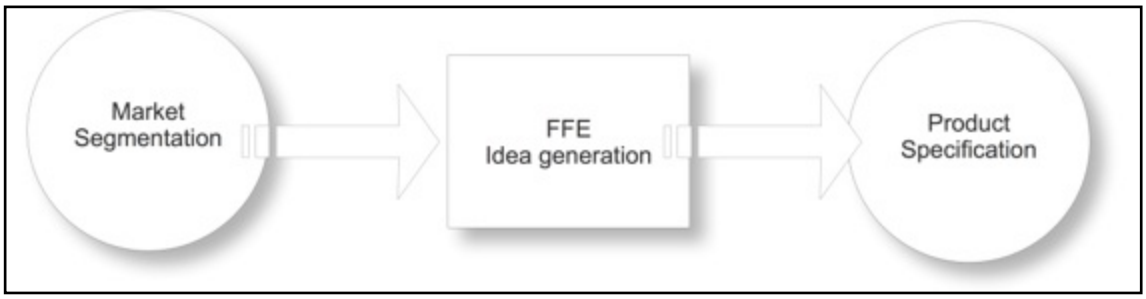


Figure 10 Definition of FFE/idea generation

There is another approach to look at the Fuzzy front end using idea generation. Idea generation, also called ideation, is the beginning of the design process, and it

is the area where designers play the most important roles. In addition, it is a creative activity involving the generation, development and communication of new ideas. Usually the cycle will be from innovation to developing the idea to be concreted and actualised.

According to Price Waterhouse Coopers' (2003) study, it is indicated that the value of the ideas is almost 70% of the company assets. Unfortunately, a vast majority of these ideas are wasted (Graham and Bachman, 2004). Therefore, the importance of good idea management can show that proper idea management can benefit the company economy.

Ideas can, therefore, be used for a very broad area in common. The categories of the ideas are suggested in 'Ideation' (Graham and Bachman, 2004), as Figure 11 shows.

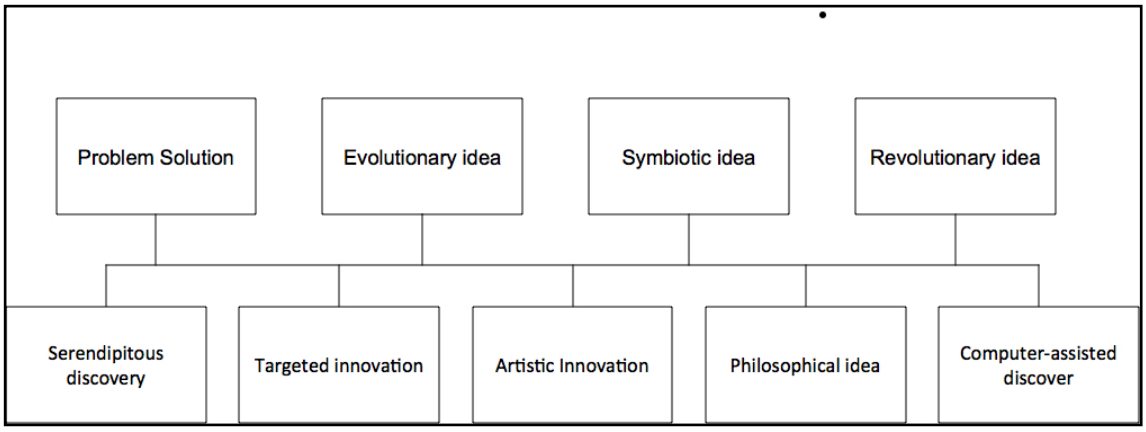


Figure 11 Category of Idea generation (Graham and Bachman, 2004).

It is not the main purpose of this thesis to discuss the detail of the ideation. However, with the use of user-centred design, which is introduced below, idea generation can be more efficiently managed to help the designers to generate ideas efficiently by UCD.

2.3. User-centred design and its approaches

The definition of user-centred design

User-centred design is widely regarded as a design philosophy. The concept of UCD is that the design should consider the users' needs throughout the design

process. Many scholars have proposed viewpoints in terms of design and user involvement. Generally, however, they are reflected as similar concepts. In addition, user-centred design is a most agreeable term, and was first mentioned in the book 'User-centred System Design: New Perspectives on Human-Computer Interaction' (Norman and Draper, 1986). Norman (1988) further elaborated on UCD in his book 'The Design of Everyday Things'. In this book, he listed many examples in order to highlight improper design and provided guidelines, accordingly.

In 1999, the International Organisation for Standardisation (ISO) formalised the process of UCD by issuing ISO 13407: Human-centred design processes for interactive systems. However, ISO 13407 has since been withdrawn and is now integrated with ISO 9241 to be issued as ISO 9241-210: Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems (2008).

There are principles in this standard:

- The design is based upon an explicit understanding of the users, tasks and environments;
- Users are involved throughout the design and development;
- The design is driven and refined by user-centred evaluation;
- The process is iterative (Figure 12);
- The design addresses the whole user experience;
- The design team includes those with multidisciplinary skills and perspectives.

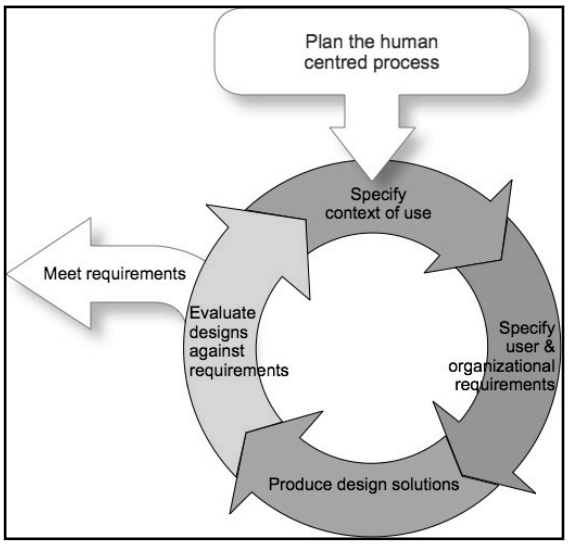


Figure 12 ISO 9241:210 Human-centred design process (2010)

This standard provides a framework for applying human-centred design and the evaluation techniques, and is intended to supplement existing lifecycle models. Although it specifies the type of activities to be performed during the development of an interactive system, it does not demand nor recommend particular techniques or methods. Consequently, various approaches have been proposed to achieve UCD. One important point from this model is that the model specifies the activities and users, but it does not say that the process has to draw users into the design activities. It still leaves the space for different UCD methods to approach.

Evolution of UCD

In the early years, the promotion of UCD was meant to solve the problems that had been encountered by certain designs, in particular those that were difficult to use and that frustrated users. Norman pointed out the guidelines for designers in his book, 'The Design of Everyday Things' (Norman, 1988), helping them to correctly design functions by considering the end-users. However, he argued in his next book, 'Emotional Design' (Norman, 2003), that design should cover not only the cognitive parts but also human emotions. Therefore, he proposed three dimensions for emotion (visceral, behavioural and reflective), and suggested that designers should not neglect the role of the user's emotions when designing. In other words, design should be customised by taking both the users' cognition and emotion into account. Subsequently, he suggested a framework for emotional design (Figure 13).

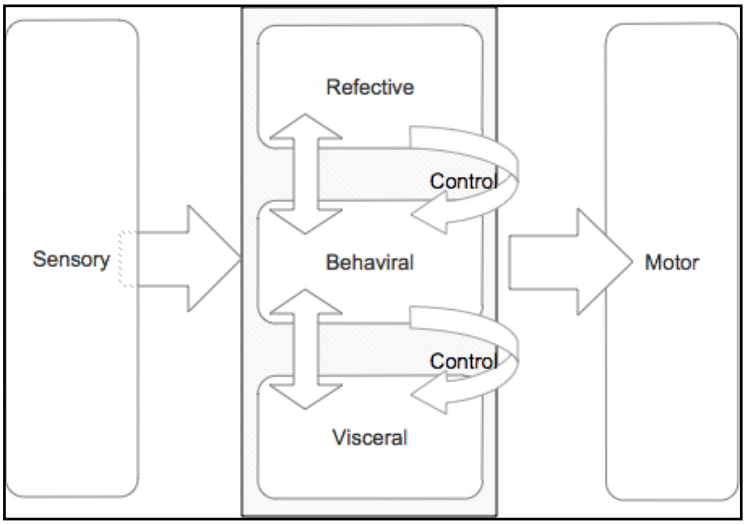


Figure 13 Norman's emotion design framework (Norman, 2003)

Jordan (2002) also has a similar viewpoint. He suggested the 'four pleasures', which are physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure. In addition, the satisfaction from function and usability is not enough to make users feel pleasure at a higher level of satisfaction. Jordan's points also indicate that user-centred design could be more complete by the explanation of advanced satisfaction. Therefore, the design is not an argument between whether you should design for aesthetics or functionality. The proportions of the design elements, such as aesthetics and functionalities, are subjective to users. Jordan's thinking shares the same concept as Norman's emotional design (2003), which is to include psychological factors into UCD. In addition, there is a similar term 'Kansei engineering', which was proposed by Mitsuo Nagamachi in 1989. It also suggested that design should consider the psychological aspect. However, Kansei engineering focuses more on the engineering in order to cement affective aspects into products using its suggested methodology.

User-experiences (UX), is a newer viewpoint of UCD. ISO 9241:210:2010 defines user experience as, 'User experience is a consequence of the presentation, functionality, system performance, interactive behaviour, and assistive capabilities of an interactive system, both hardware and software. It is also a consequence of the user's prior experiences, attitudes, skills, habits and personality'. In other words, user experience is regarded as 'all aspects of user perception when

interacting with the products, services or systems'. This is an upgraded version of the description since ISO 13407. UX places the emphasis on the user's perception of data while experiencing products, before interpreting the UX data and transforming them into a design. Consequently, to satisfy users from the interaction, UCD is brought forward. UX is, to date, the latest version of UCD (see Figure 14).

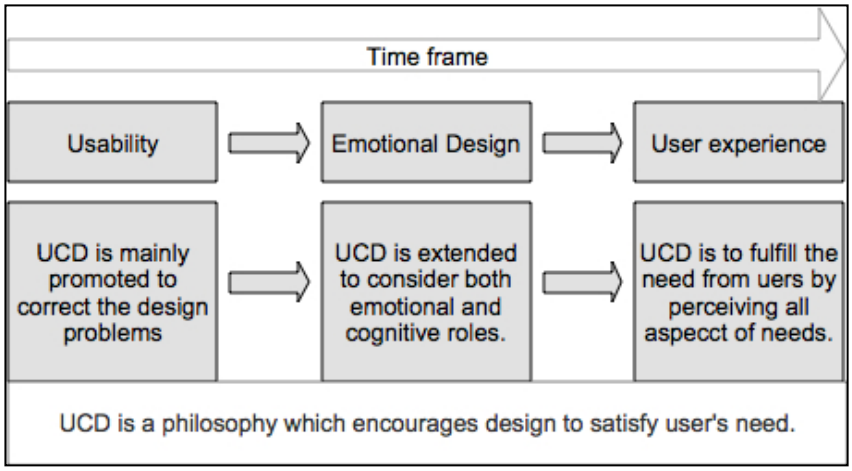


Figure 14 The Evolution of User-centred Design (UCD)

Critique of UCD

User-centred design, however, is not always the best design strategy in product design. Sometimes, other design thinking might be considered better than using UCD. Taking activity-centred design (ACD) as an example, some tools, such as kitchen utensils, garden tools, and woodworking tools, are similar, even in different cultures. Humans can still easily learn how to use them. The reason for this is that 'they were developed with a deep understanding of the activities that were to be performed' (Norman, 2005).

In Norman's article *'Human-centred design considered harmful'* (2005), he raised some concerns regarding UCD. Too much focus on certain groups or users will lead designers to tailor the design to their needs, and the result might be that the

product may not be appropriate for others. Even worse, it may increase the product cost as more users' needs are considered.

In the situations Norman mentioned above, he encouraged designers to use ACD to compromise the users' needs and avoid the problems that occur from the use of UCD. However, this is not an argument to rule out the importance of UCD. It is just to show that sometimes there is a better design tool instead of putting users into the design consideration.

Another paper is titled **'**Usability Evaluation Considered Harmful (Some of the Time)' (Greenberg & Buxton, 2008). Without reading this paper, audiences may think this is a negative review of UCD, as usability is mostly considered as a UCD evaluation method. The paper gave reasons and consequences to explain when the usability method is dangerous to use; as they stated: '*The problem is that academics and practitioners often blindly apply usability evaluation'* (Greenberg, S., and Buxton, B. 2008).

This argument is actually providing a warning that the usability evaluation might cause harm if it is not carried out correctly.

In John Wood's (2012) article '*Why user centred design is not enough*?', he pointed out: **'***One of the problems with this post-feudal, user-centred mindset is that it is a one-dimensional map in which only two places exist - master and servant. In the workplace, the designer is the servant and the client is the master. From a greater distance, the user is the master and the "client plus designer" is the servant. Apple products may look cool on a small, consumer-centred map, but they might not look so smart on the big map, especially if we can see their true ecological footprint. This model is failing us all, because it ignores everything outside our myopic economic reality*." He proposed a concept that refines the eco-centred approach. The model was standing by multiple agents which form an ecosystem. This new viewpoint is rather new. However, this model does not take the position of clients (users) out of consideration.

There are also critics of the UCD methods, and known drawbacks when considering placing users physically into the design practice. The drawbacks found

are recognised as high costs, time-consuming and complex in skills (Chen et al., 2009).

To conclude this section, UCD is not the only key to success. Even though UCD is practiced, there are important and appropriate procedures to avoid damage. In addition, putting users into the design consideration is just an essential and does not mean that UCD is better than all other design models. This thesis does not attempt to prioritise UCD, ACD or any other theory. It is intended only to draw attention to getting users involved in the design as one of the design considerations.

The conventional approaches of UCD

Even though UCD has a philosophy and an ISO standard (ISO 9241:210) to provide guidelines, it is not possible to realise UCD without having proper methods in place. There are many methods suggested across the different stages of product development, and three major approaches for the UCD process, namely participatory design (PD), empathic design (ED) and contextual design (CD).

Participatory Design

- **The Origin and Definition of Participatory Design**

Participatory Design (PD) is a maturing field of research, and a biennial, international PD conference has been held since 1990. The term was first used in North America. Interestingly, the idea of participatory design is the same as cooperative design, which emerged from the Scandinavian tradition in the 1970s. In fact, the context of participatory design began with the democracy movement in Scandinavia and was when labour unions called for more democratic controls to improve their work conditions (Ehn, 1989).

PD defines that users should participate in the design project throughout the whole design process and focuses on the equality between the designers and the users. In other words, it is a type of democratic thinking where design decisions are made

through cooperation between users and designers.

Due to its nature, which includes the user in the project design process, it is commonly used in urban design, architecture, landscape architecture and planning as a way of creating environments that are more responsive and appropriate for their inhabitants' and users' cultural, emotional, spiritual and practical needs.

- **The Techniques used in Participatory Design**

PD demonstrates several techniques for user involvement and discussion. These techniques eliminate the gap between the designers and end-users by using the following methods:

1 Mock-ups by computers (Ehn and Kyng, 1991)
2 Traditional paper-based outline of the product (Ehn and Kyng, 1991)
3 PICTIVE (Plastic Interface for Collaborative Technology Initiative through Video Exploration)(Muller, 1991)
4 CARD (Collaborative Technology Analysis of Requirements and Design) (Tudor, 1993)

Contextual Design

- **The Origin and Definition of Contextual Design**

The concept of contextual design (CD) has been developed by Hugh Beyer and Karen Holtzblatt since 1998. It shares the ideas of participatory design and invites users to take part in the whole design process. Great product ideas come from the integration of the detailed understanding of customer needs together with an in-depth understanding of technology (Beyer and Holtzblatt, 1998). Therefore, CD begins by understanding how customers work by observing their context of use, hence the term 'contextual inquiry'. In addition, CD incorporates anthropology to gain good recognition of a customer's behaviour and to form a platform to help a cross-functional team to discover customers' actual needs. It then provides a systematic procedure for designers, as follows:

- **The Techniques of Contextual Design /Contextual Inquiry**

1 Interpretation sessions and work modelling
2 Consolidation and affinity building

3 Visioning

4 Storyboarding

5 User environment design (UED)

6 Paper prototypes and mock-up interviews (Beyer and Holtzblatt, 1998)

Empathic Design

- **The Origin and the Definition of Empathic Design**

Empathic design (ED) was first addressed in the Harvard Business review (1997), highlighting that a successful product must meet or perceive customers' needs. Nevertheless, the customers' ability to guide the development of new products and services is usually limited by their experience and an insufficient ability for imagination and demonstration of innovation (Dorothy and Rayport, 1997). To tackle such tough situations, empathic design, a helpful tool for designers and developers, has been promoted.

Empathic design is an approach to UCD where the designer attempts to get closer to the lives and experiences of the end-users, and to incorporate the insights gained from the end-users into the design process. The goal of empathic design is to ensure that the product or service designed meets the end-users' needs and is usable (Dorothy and Rayport, 1997).

Empathic design can be seen as a move by researchers and developers into the world of the end-users, whereas participatory design can be seen as a move by end-users into the world of researchers and developers. In Figure 15, the differences in the relationship are revealed between users and the approaches to participatory design and empathic design.

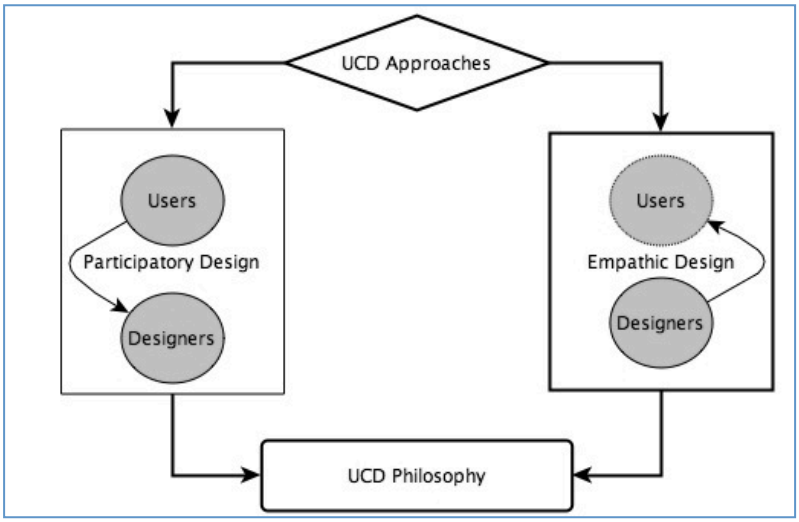


Figure 15 Users vs. Participatory Design and Empathic Design

Additionally, the empathic design approach seeks to meet users' needs, and further investigates the pathways to understand users. This research inherits this concept and aims to make users feel pleasure when interacting with a product, becoming a more advanced level of meeting user needs.

- **The Techniques of Empathic Design**

The main technique of empathic design is observation. Unlike other types of traditional design research tools, such as focus groups and usability laboratories, observation must be conducted in the user's environment so as to watch the user's daily routines.

The techniques of empathic design also include an understanding of anthropology. A five-step process is suggested, as follows:

1. Observation
2. Data Capture
3. Reflection and Analysis
4. Brainstorming for Solutions
5. Developing the Prototypes of Possible Solutions (Dorothy and Rayport, 1997).

Emerging UCD approach: Personas

- **The Origin and Theory of Personas**

Since Alan Cooper (1999) first promoted personas in his book, 'The Inmates are Running the Asylum', personas have been widely used in the computer science domain. Personas are fictional characters provided with user profiles that can represent a group of people. By providing personas in a design, stakeholders' attention on the users can be maintained during the design process and, therefore, it is also a UCD approach. Before personas were introduced, as Pruitt and Adlin (2006) pointed out, 'when UCD was new, to simply use "user" in design was powerful. Unfortunately the word "user" is not enough to foster effective UCD'. Therefore, the theory of personas is based on human psychology support. A psychologist, Grudin (2006), addressed the evidence as to why personas work:

- We naturally model ourselves on other people
- Models of fictional people can be as engaging as models of real people
- The models are often detailed and complex

- **Benefits of using personas**

Microsoft is a pioneer company in persona research and there are many findings from research undertaken by the organisation. The most famous example is how they used personas to develop their popular software, such as 'Office' and 'Messenger', finding that the use of personas was of great benefit to the design tasks. Personas are powerful tools due to the nature of their two strengths. One is that, as an effective tool in communication, they make the conversation easier; they help to cement the discussions within a team and to eliminate blurred discussions. The other is that they help a team and an organisation to become more user-focused, thereby helping them to make better decisions.

The benefits of using personas are listed as:

- Increasing the products' usability, utility, and general appeal
- Streamlining the teams' processes and improving staff abilities to work together
- Enabling a company to make business decisions that help both the company and its customers
- Improving the company's balance sheet. (Grudin, 2006)

The creation of personas

As Cooper (1999) mentioned in his book, the idea of personas is simple but, to make them workable, it is necessary to rely on a precise description. Many scholars have suggested similar guidelines to help designers to create personas. However, the richest and most complete information is contributed by Pruitt and Adlin (2006). In their book 'The Persona Lifecycle', they provide fruitful tips and examples of persona creations. Even though there are many variations available when constructing personas, the main secret is to provide real user profiles from user research that will support the imaginary characters.

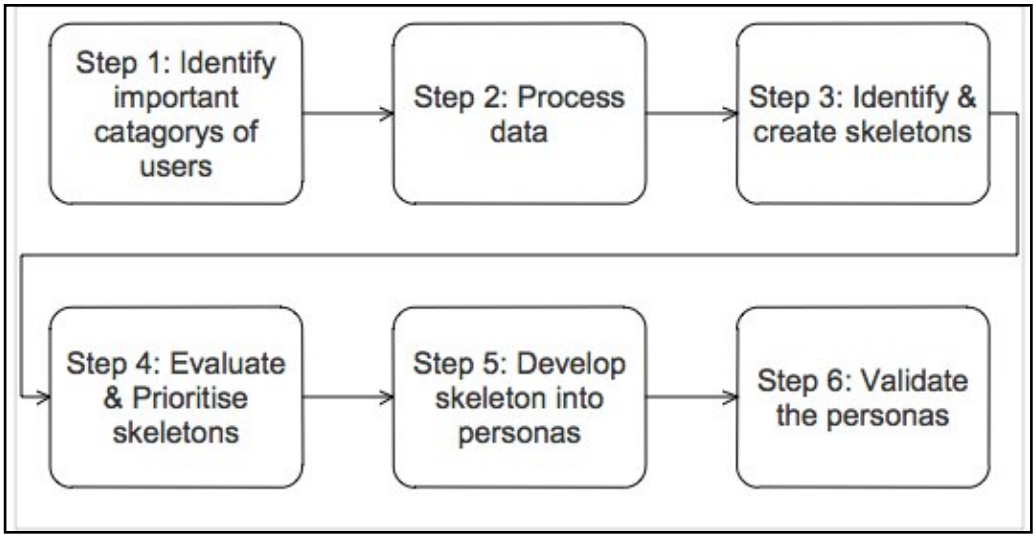


Figure 16 The six-step persona creation process (Revised from 'The Persona Life Cycle' (2006))

Pruitt and Adlin (2006) suggested six steps when creating personas, as Figure 16 shows. Even though these steps look complex, the most time-consuming period when creating personas depends on the project schedule and how long the personas will be used for in the project. It can be less than a day's work for rough detail or, for bigger projects, more days with more detail worked into every step. For example, if a low-budget project over one week or two is considered, then it is suggested that assumption personas are used, and the steps are reduced:

Figure 17 Illustration of agile persona creation. Pruitt and Adlin (2006)

Table 1 Usage frequency of persona characteristics. (Revised from 'The Persona Life Cycle' (2006)

Basic Details		Job/Work information	
Name	90%	Typical Activities	92%
Photo/Illustration	71%	Job Title	84%
Personal Information		Goals	81%
Age	84%	Job Description	74%
Fears/Obstacle	75%	Company/Industry	65%
Motivations	67%	Challenge Areas/Breakdowns	61%
City/State/Country	61%	Interaction with Colleagues	61%
Technology Access and Usage		Work Style	61%
Technology Opinion/Attitude	68%	Others	
ISP/Connection Speed	83%	Relationship to your product	83%

This table only shows the most frequent persona characteristics; the frequency of use abstracted is over 60%. This is used to help shape the skeleton of the personas and cement the details rapidly.

A question often asked is, how many personas should we create? There is no specification that defines the number of personas. However, too many personas may detract from the design and the users, and the decision-making process will become more difficult. However, it does not indicate that only one persona should be employed since there is the tricky reaction of 'it just does not feel right' (Pruitt and Adlin, 2006). Cooper (2003) suggested that, 'each primary persona should require a unique interface'. Therefore, it is possible to use just one persona for the whole project or create a different persona for each interface. Hence, this becomes the guideline for the number of personas used. In addition, secondary personas can be used in order to prioritise the requirements.

The use of personas in the early stages of the design process

Although personas can be used throughout the whole design process, only the literatures concerned with the scope of the early stages of design were sufficient to support this thesis. The main concept of employing a persona is simple; in Cooper's book (2003), he suggests replacing the term 'user' to 'created persona'. There is a more detailed description provided in Pruitt and Adlin's book (2006), but the principle remains the same as they suggest that you 'ask your persona to tell you their stories' (Pruitt and Adlin, 2006). In addition to the invitation by the persona, replacing ambiguous terms, such as 'the user, 'the lady', with specific personas, allows these personas to be mixed and used with other design methods.

In the planning stage, there are two main tasks: to determine the product requirements, competitive reviews and brainstorming; and to prioritise the requirements and ideas. In this thesis, the focus is only on the first stage, which is idea generation and ascertaining the requirements (Fig 18).

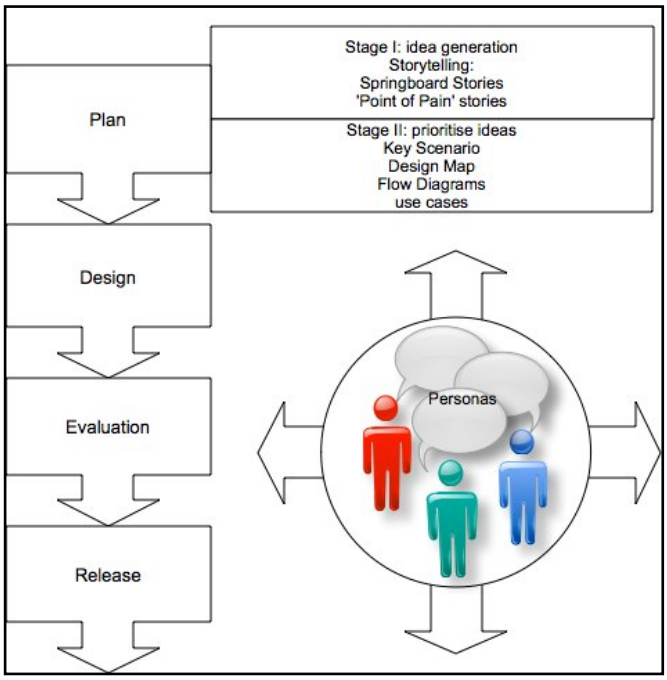


Figure 18 Personas used in the design process and methods in the early stages of the design.

2.4. Service Design and Computer-aided Design (CAD)

Service design and service engineering

Service design is a UCD activity which aims to provide a good user experience

(UX). It involves agents related to the UX delivery process, including tangible and intangible products (Fig 19). In other words, service design can be used to increase the value of the tangible products in order to deliver a better UX. Regarding the service design, it is said that '*Service engineering (SE) is a discipline to increase the value of artefacts and to decrease the load on the environment by reason of focusing service*' (Sakao, and Shimomura, 2007).

In addition, as with the process of constructing solutions to increase the use of UCD/UXD in later chapters, it has been learnt that solutions cannot be completed by one session of problem-solving alone. Therefore, this thesis introduced the idea of service design in order to provide design practitioners with a total solution. This is concluded by using the service-engineering concept to build a computer-aided design (CAD), addressed in the next section.

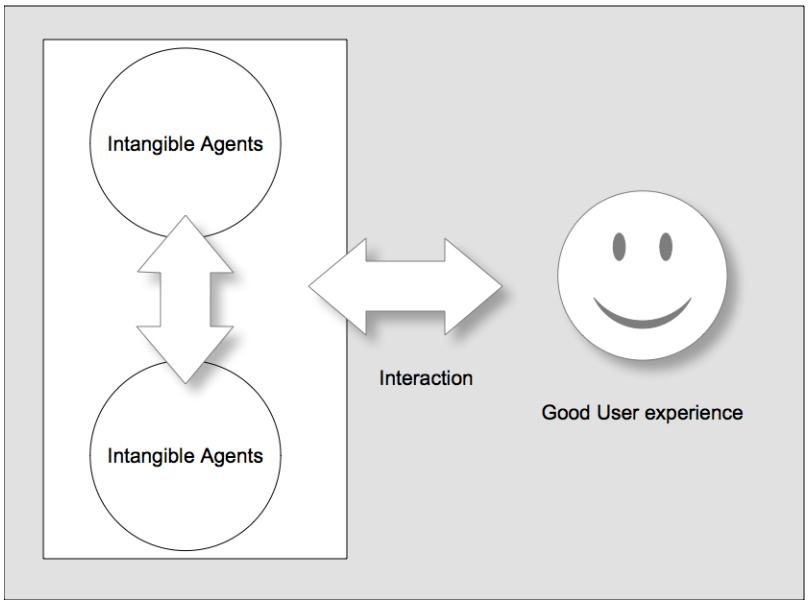


Figure 19 Service design concept

Computer-aided design (CAD)

Computer-aided design (CAD) refers to the use of a computer system to assist in the creation, modification, analysis, or optimisation of a design (Ranky, 1983). CAD is often offered as a tool to facilitate the activity of designing. By looking at the definition of service engineering (SE), it is possible to find the similarities between CAD and SE as '*SE aims at intensifying, improving, and automating this whole framework of service creation, service delivery, and service consumption*' (Sakao

and Shimomura, 2007).

There are several benefits mentioned by Ranky (1983):

- To increase the productivity of the designer.
- To improve the quality of the design.
- To improve communications
- To create a database for manufacturing.

Since CAD is also one type of human-computer-interactive system, it has user-centred characteristics. Therefore, the design flow should also be compiled using ISO 9241.

Nevertheless, CAD is commonly referred to as a graphic or visual design tool nowadays. In order to avoid the confusion when reading this thesis, the term 'application software' will be used in later sections when substituting computer aided design (CAD).

2.5. Methodology

Introduction

In this section, the methods used in this thesis will be illustrated, together with how the methodology was constructed for this work. In addition, the main methodology can be presented as several subsets, as follows:

- Identifying the problems at the stage of UCD idea generation, as employed in chapter 3.
- Exploring the idea by considering user requirements so as to form a theoretical model to promote the usage of UCD practice, as employed in chapter 4
- Validation of the tendency for user-centric ideas, as employed in chapter 5
- Making software architecture from a UCD model, as employed in chapter 6
- Usability test for evaluating a persona application software structure, as employed in chapter 7

- Methods of data analysis, as used in chapters 3, 4, and chapter 7

Each topic above aims to bring a contribution to the methods employed in the UCD domain and the combination of these topics constitutes the methodology of this thesis, as shown in Figure 20.

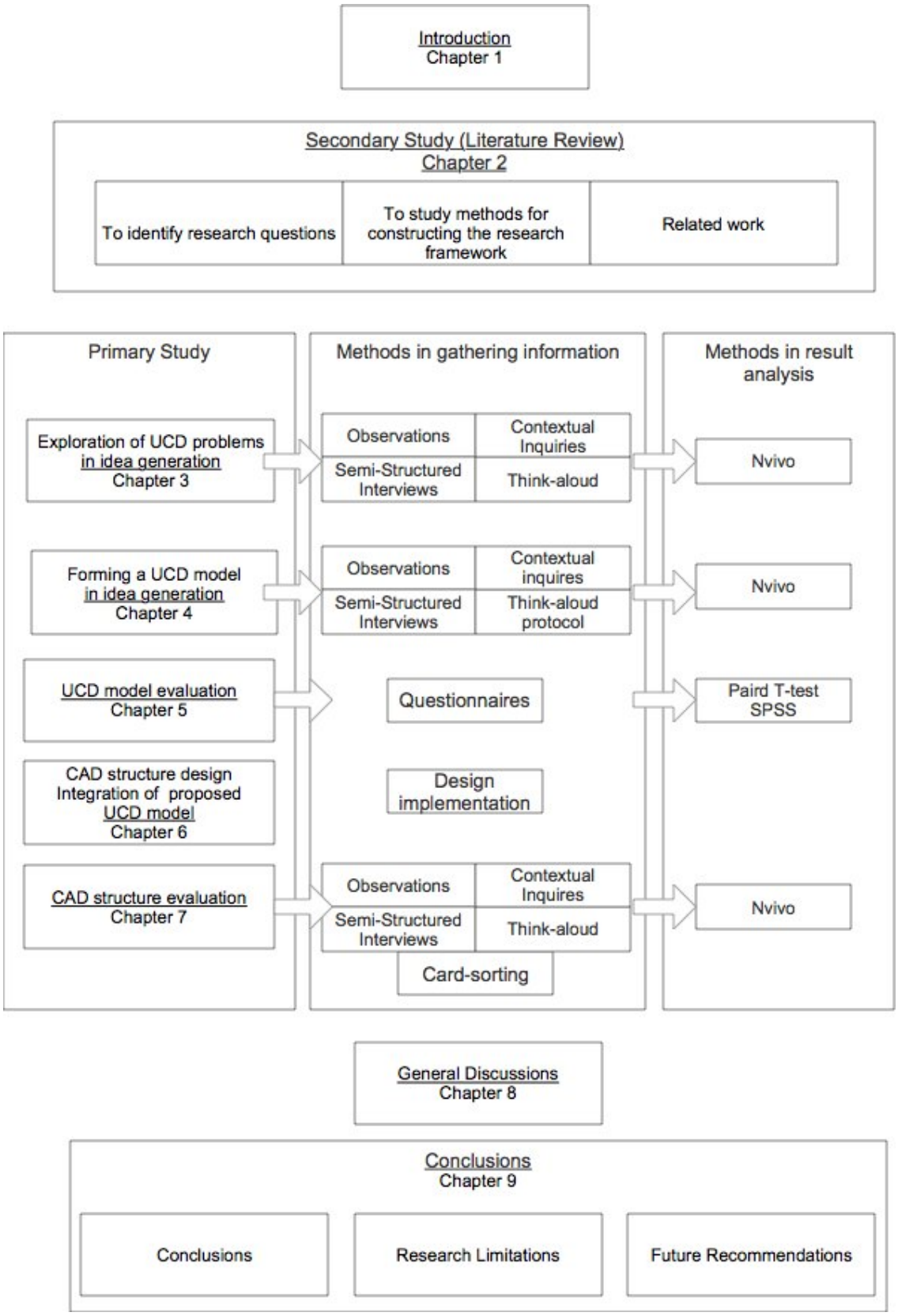


Figure 20 Research Methodology

Identifying the problems in idea generation

Define the questions:

In the real world, we are frequently frustrated by the many products we interact with. However, this does not make sense since UCD is one of the most recognised theories in the design field and has been promoted for many years. Therefore, there are two questions at this stage: Why is UCD not used? And why are designs not user-centred? To answer these questions, several assessments were arranged.

Introducing mixed-UCD methods to identify the questions

There are many methods that can be used to explore the problems defined above, such as observation, contextual inquiries and methods suggested by other UCD researches. The design of the exploration process for this thesis also considered the efficiency of the process. Therefore, various methods for think-aloud protocol were selected, together with observations, contextual inquiries and interviews.

Think-aloud protocol (TAP) is often used as the method for the usability test in product design. It is the method which requires participants to say whatever they think when in the process of interacting with the product under test. This method originated from the methods of verbally reporting data (Ericsson and Simon, 1980). Using this method, it is possible to understand the meanings when participants are undertaking actions during the tasks. It is usually used in a video and audio recording environment, enabling the observer to analyse the data later.

Sometimes, participants say what they think the researcher wants to know, based on their knowledge. However, if they are observed without such knowledge, they may, in fact, do things differently. Therefore, observation together with contextual inquiries may be sufficient enough to squeeze the data from the same process. Contextual inquiry is a UCD method and is very effective but skills in anthropology also need to be obtained in order to use it perfectly. Unlike questionnaires, the answer is collected within the expectations. When the moderator knows how to use the method correctly, a contextual inquiry is more like an open interview and it may lead to some surprising results. Therefore, methods used with the components of think-aloud protocol, observation and contextual inquiry can be effectively employed to help explore the problems. The sequential activities are shown in

Figure 21.

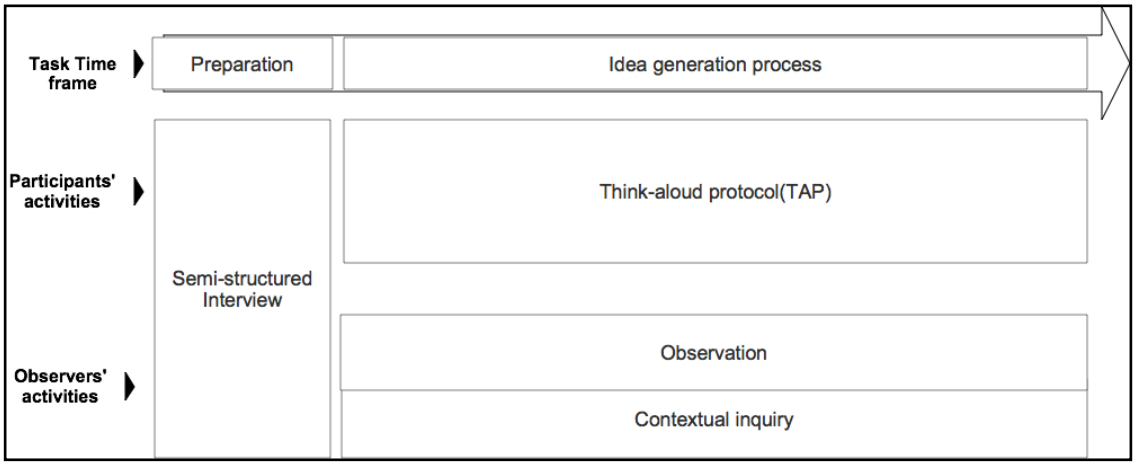


Figure 21 Mixed methods used during the task execution by time frame

Exploring the idea of considering user requirements

- **Conventional UCD approaches**

- If the UCD process is broken down further, there are many other methods that can be suggested in order to achieve UCD. As explained in chapter two, the literature review, designers contribute the most in the early stages of a design and it is this area that is of most interest to this thesis. Therefore, only the approaches that can be used in idea generation will be discussed.

- As mentioned in the literature review, the approaches used towards UCD realisation are contextual design, participatory design, empathic design and personas. These approaches aim to provide a pathway to operate UCD throughout the complete design process.

- Contextual design, participatory design and empathic design differ in several ways but they all help to operate UCD. However, they also stress different aspects. Participatory design places the emphasis on equality between the users and product developers, as mentioned, in a democratic way. Contextual design emphasises the anthropological skills required when gathering data from users. Finally, empathic design helps designers to understand the users.

- In a participatory design, user involvement is, obviously, crucial. The design activities should be like a conversation between the designers (or product

developers) and users. To conduct these kinds of activities effectively, the designers need to be moderators during the meetings. When there are disputes in the group, the moderators will need to be able to arbitrate and carefully analyse what the real need is or what will benefit the users. This requires anthropological skills and certain personality traits of the researchers, and these requirements may prevent certain designers from practicing UCD correctly. Contextual design also prompts that UCD work relies on good anthropological skills.

- In terms of empathic design, because the aim is to enable designers to understand the users instead of having a strong anthropological background, simulation tools are often suggested that can help designers to understand the users even when they have different conditions, such as being elderly or disabled. However, it is apparent that designers with better research skills may be able to use observation better.

- Therefore, even though all the design processes mentioned encourage user involvement, involving users throughout the design process is a key aspect only for participatory design. Contextual design and empathic design are different as the users do not need to be involved or stay with the designers after the anthropological data is collected. The more there is user involvement, the longer the product cycle and the higher the cost will be. On the other hand, contextual design and empathic design may be cost effective methods for a project.

- Nevertheless, in contextual design, either the designers or the anthropologists will need to act like researchers so as to aggregate the user data. There are no such limits in empathic design since the concept of 'understanding users' can be very abstract, but can also be a drawback as well. Interestingly, simulation tools, such as a third age suit, have now been developed (Hitchcock and Taylor, 2003).

- This approach (ED) does not need to ask users to be involved if the designer has certain ways to understand their users, but the conventional UCD does require user involvement, as seen in figure 22.

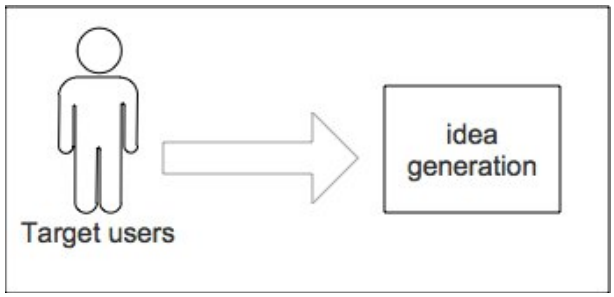


Figure 22 Conventional idea generation

- In fact, only a few large companies have adopted empathic design because of the difficulties of interdisciplinary work and underdeveloped skills. The difficulties are mostly recognised as budgetary issues, time, and complexity in manipulation skills (Chen et al., 2009). However, this approach is a relatively cost-effective way to identify potentially critical customer needs.

- To conclude, empathic design may be a better way to make UCD more popular since it requires the least skills and is also cost effective. This research, therefore, adopts empathic design as its main concept for understanding how to approach UCD. To understand users with special physical conditions, a simulation tool can be used, and personas can also be effectively utilised to aid the understanding of general users.

    - **Forming a new UCD model through the complete idea generation process**

- Empathic design may bring benefits if the process of 'user involvement' is separated. Instead, user involvement can be identified as two stages, namely user research with real users, and virtual users applied using the data from real users. The virtual users are personas and some will argue this is not a new point. The concept can be seen in Figure 21. Nevertheless, the key action for this idea in the thesis is to split the job of 'user research' into two parts: 1) the user research; 2) apply the data after the user research. As previously noted, 'design practitioners' and 'design researchers' are usually different. Most design practitioners have learnt to do practical design, such as drawing, creating ideas, detailed designs, etc. Design researchers, on the other hand, are good at observing and have analytical abilities in user research. Even though the capabilities of the designers from the two categories are not necessarily either solely as practitioners or researchers, the assumption is that they are different and this is further proven in Chapter 4

- As Figure 23 shows, conventional UCD is a job usually executed by the same designers. The new concept of the design job has been intentionally divided into two sections; the left-lower section of the chart is suggested to be done by the design researcher while the right-side section of the chart indicates the processes of the designer practitioner. This makes it easier for the practice of design.

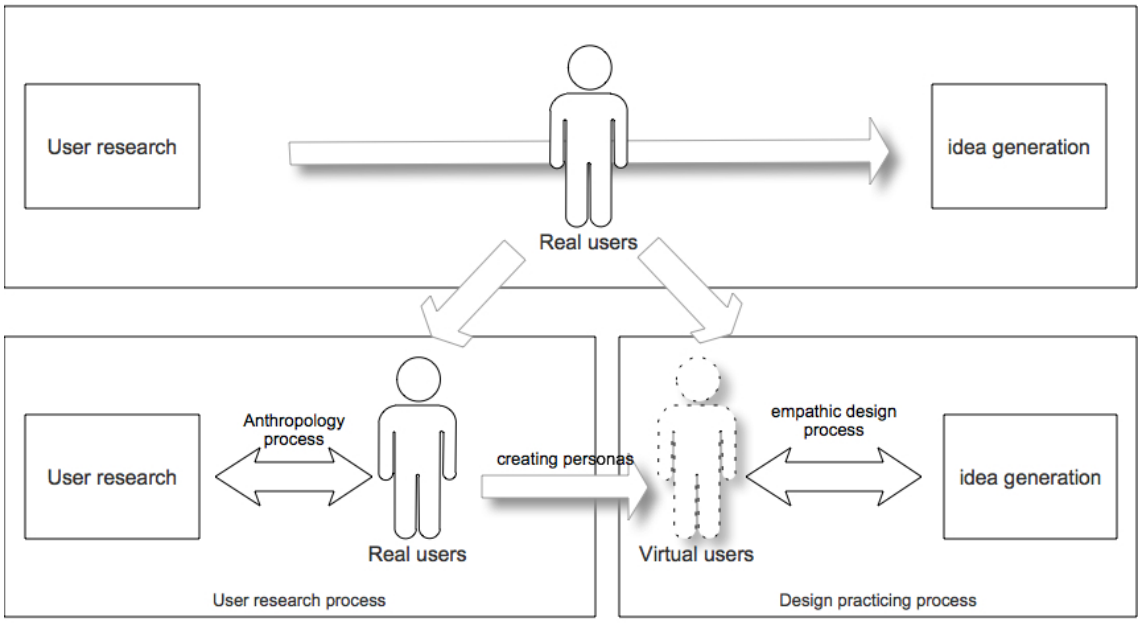


Figure 23 Dividing the design work into two processes

- **UCD methods and idea generation**

- Idea generation methods are plentiful. They are, however, built by different rationales, as discussed in the literature review. As idea generation is at the fuzzy front end of concept development, it is an area where designers play an important role compared with other stages of the design process. Even though this research is not limited to particular stakeholders who are involved in idea generation, it still further narrows the research scope to ‘designers’ in idea generation in order to encourage more designers to practice user-centred design.

- Idea generation with user-centred thinking could have happened before or after user-centred thinking and specifications are defined for the targeted users. No matter what the sequence is, the important thing is to abide by the user-centred design principles. Ideally, the most efficient way is if each idea has been generated while considering the users’ needs. In this chapter, idea generation with UCD is

explored as the best methodology. There are also doubts as to whether the UCD method confines the creativity of the design, as discussed in later chapters.

- The preliminary model has been based on virtual users with empathic design. In this stage, a design task was given and participants were asked to only interact with the virtual users. The virtual users were created by the researcher from real user profiles. The skills conducted here are similar to the mixed UCD methods: TAP, contextual inquiries and observations. The model creation is demonstrated in Figure 24. Firstly, a basic model framework was proposed and several elements that will form the UCD model later. Using the skills mentioned earlier, the mixed methods are then observed to see how the participants interact with the basic model, its elements and their current design tools. The new UCD model will not be formed until this information is processed during the analysis stages, which will be introduced in a later section.

- Even though the design pattern in the UCD idea generation can be concluded to form a UCD model, expert opinions were taken to refine this UCD model for idea generation.

- The expert review was a method suggested in the usability test, and one of the methods employed in this research is the cognitive walkthrough. A cognitive walkthrough is an examination of certain tasks performed by usability specialists using the user interface but which tries, at the same time, to identify the role of real users and their usage situations (Wharton, 1994). In this task, our expert is asked to follow the proposed preliminary UCD model, and offer their views to refine the UCD model proposed.

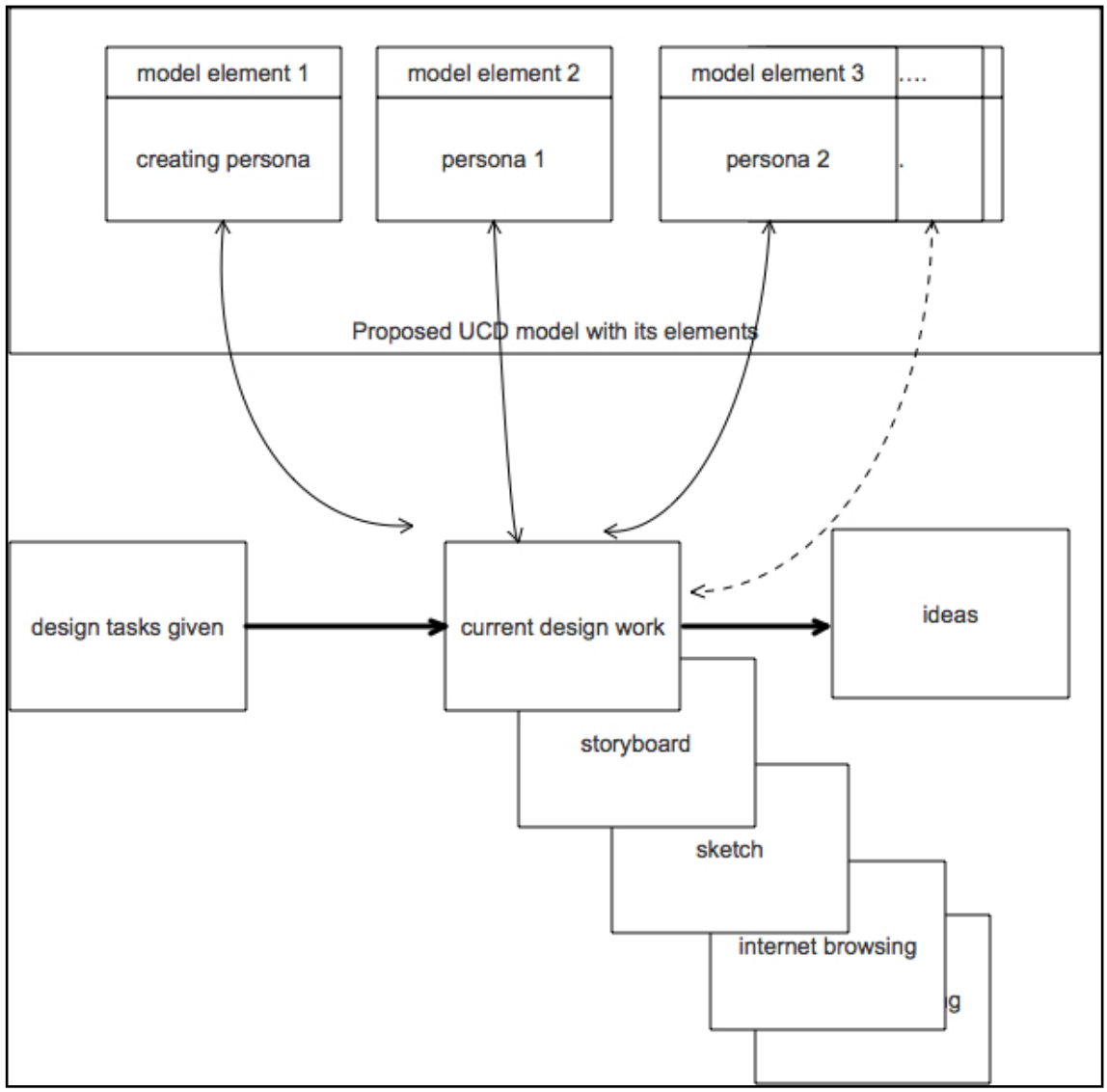


Figure 24 Forming the preliminary UCD model

Validation of the tendency for user-centred ideas

Since idea generation itself can be influenced by different scenarios, it means that the ideas which have been generated are not always user-centred. A UCD model for idea generation was made in collaboration with design practitioners and design experts during the previous process, but there is another question at this stage: Even if the design practitioners feel they are benefitting from this UCD model for idea generation (self-satisfaction evaluation), are the ideas really user-centred? From the previous process, it was noted that designers are not always aware of whether or not the design process is user-centred.

Consequently, it is necessary to gather opinions from the target users in order to

launch the second evaluation, as shown in Figure 25. Therefore, the plan was to gather the opinions of the target users by providing them with designated sets of ideas. Questionnaires with two sets of ideas from design practitioners were designed. One set is a design following the new UCD model, whereas the other is a set designed before using the new UCD model.

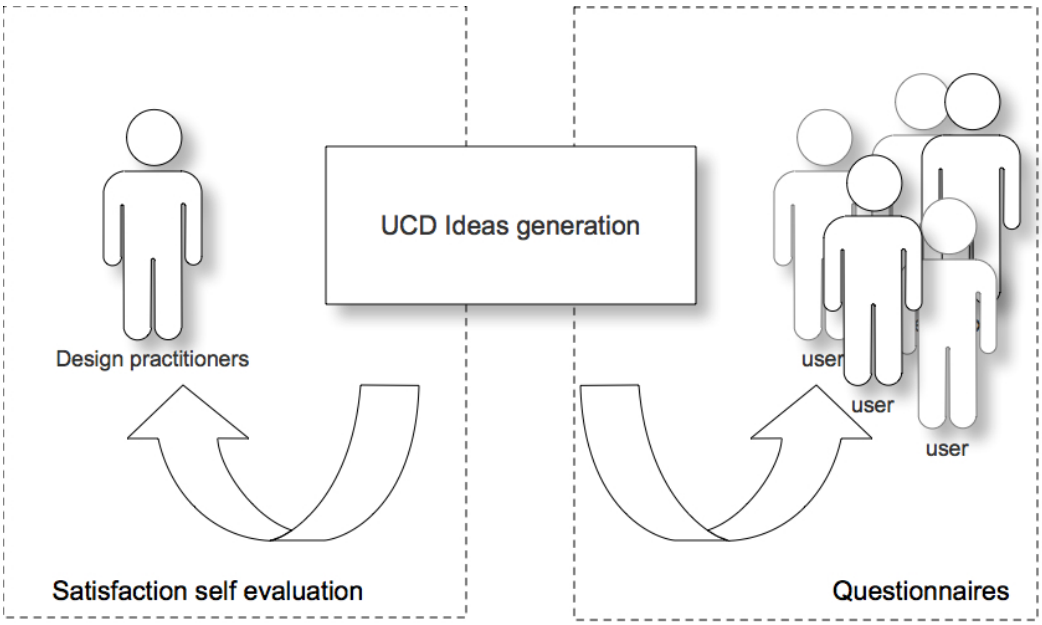


Figure 25 Double evaluation process to examine the UCD tendency

Later, two sets of data were used in the statistical process and a paired T-test to see which set was preferred by the target users. By doing this, verification of whether the UCD model was effective was obtained in advance.

Making an application software architecture from a UCD model

As discussed in the literature review, application software can benefit designers in their design work because it is cost effective and is probably less complicated when lots of information is embedded into the application software process. In this research, it has already been noted that design practitioners are not researchers and it is impractical to expect design practitioners to have the skills in user research.

By developing application software, there will be a clear-cut method for design practitioners and design researchers. Design practitioners can focus on idea generation through the application of this application software, whilst researchers

can provide trustworthy research data to feed into the application software.

A plan for the application software architecture is important as it will make the job functions clearer. In addition, the structure of the application software has a clear mission since the users for each part of the function are known. The key users of the application software are design practitioners.

Refining the software architecture by evaluation with design practitioners

After the initial plan was structured for the application software, integrated with the proposed application software model, it has to be further examined by the users, namely design practitioners. There is a useful method used called card sorting (Figure 26) and this gives a further evaluation of the completeness of the software structure. Card sorting is often used in usability tests, which gather structured information by interacting with users. As Rugg and McGeorge referred:

'*The sorting techniques are an invaluable part of the knowledge engineer's or requirements engineer's toolkit. They are simple to use and combine flexibility of use with a highly formalized representation formalism, bridging the gap between qualitative and quantitative techniques*' (Rugg and McGeorge, 2005).

Figure 26 Cards for validating the application software construction.

Card sorting skills are very useful when used to explore the context from users' viewpoints about a new project, especially when the organisation scheme is still blank. It is also very useful when it is necessary to know the problems in a current organisation (Spencer, 2009).

Card sorting is simple and cheap but it is also powerful. The steps below are suggested in the book 'Card sorting: Designing usable categories' (Spencer, 2009):

1. Decide what you want to learn
2. Select the methods (open, closed, face-to-face or remote, manual or software)
3. Choose the content
4. Choose and invite participants
5. Run the card sort and record the data
6. Analyse the outcomes
7. Use them In your project (Spencer, 2009)

There are many different classification schemes that can be found:

- Topic
- Chronology
- Geography
- Alphabetical order
- Numerical order
- Audience
- Task (Spencer, 2009)

The categories are not required to be either independent or to have neat boundaries with each other; the important thing is that the level of hierarchy can be defined (Spencer, 2009). Therefore, in this research, the cards used were categorised into four sections, as the figure 27 shows.

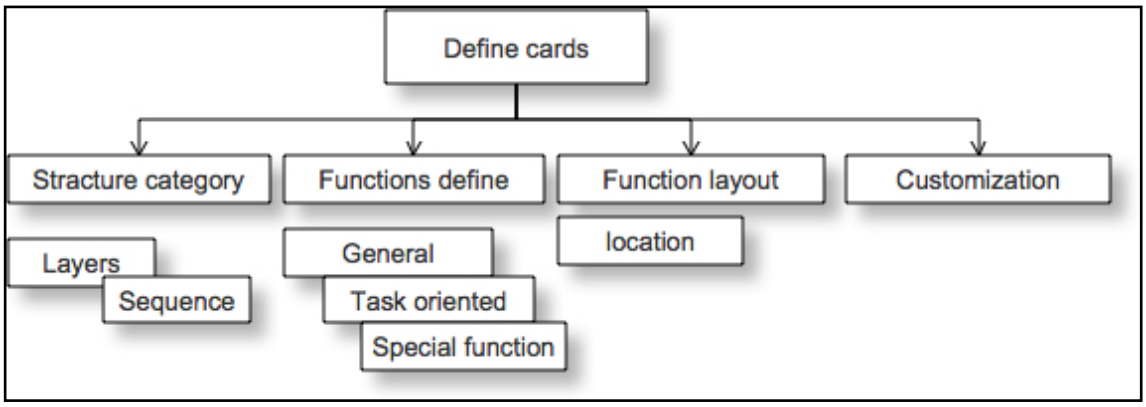


Figure 27 Definition of cards used in this research

Data analysis in this research

A large portion of this research has been done with a qualitative study. There were, primarily, two different methods used in the data analysis: NVivo and SPSS.

NVivo is a software tool called Computer-Assisted Qualitative Data Analysis Software, CAQDAS. It is used to transcribe data, and do the coding if required. Since this research mostly gathered data qualitatively, a scientific way to organise the data was needed. NVivo is software that can be used in qualitative and mixed methods.

NVivo provides an environment where you can code/encode the information, and later provide the kits to group similar information into several categories. Furthermore, the researcher can propose theories and findings because of its clear contextual presentation. Therefore, the most discussed term linked with Nvivo is Grounded Theory (GT).

The origin of the grounded theory method was developed by two sociologists, Barney Glaser and Anselm Strauss (1967). GT has been recognised as being widely used in sociology to sort out the pattern of the pragmatic phenomenon. Unlike some research types, which propose a hypothesis and then validate it, grounded theory starts the research by gathering information. It is a systematic methodology in the social sciences and involves the discovery of theory through the analysis of data (Martin and Turner, 1986).

This research used a similar process to GT. However, there was one major difference between this research and GT. First, this research was based on several

hypotheses to initiate the assessment. However, the process of information collection and analysis was a useful reference to this research. Many related studies have provided encoding skills under GT. However, because some of the information was available before the assessment, this research had already proposed the hypotheses. The coding process was much easier in this case. Therefore, analysis methods were concluded for both the specific questions and non-specific questions. Figure 28 shows the systematic analysis flow in this research. Additionally, the encoding process is also demonstrated in Figure 28.

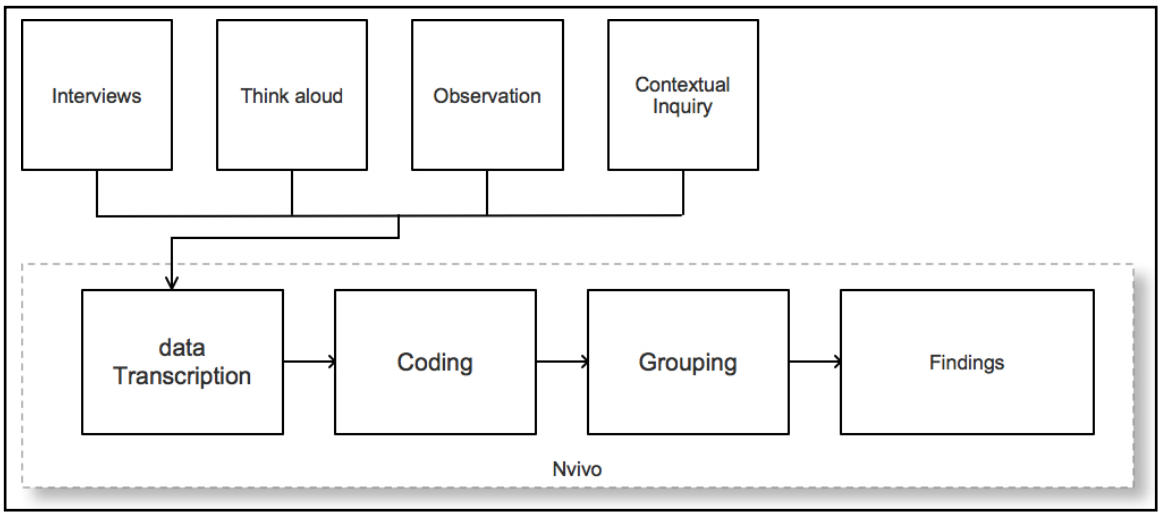


Figure 28 Research data process and analysis in NVivo

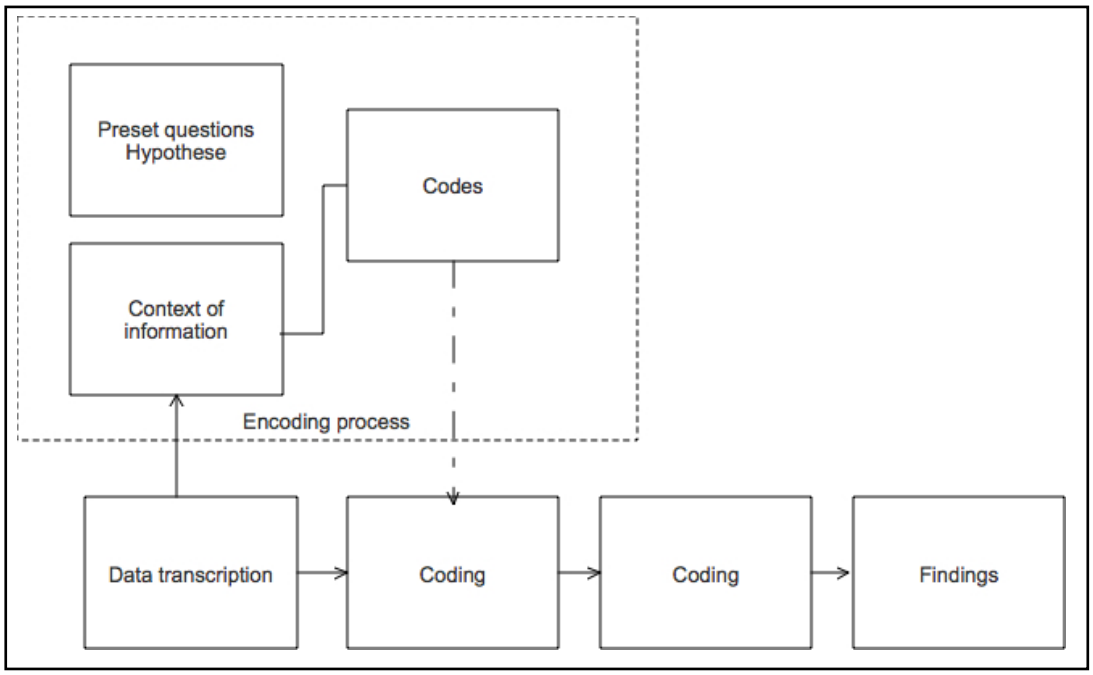


Figure 29 Encoding process

This research also conducted a quantitative process to validate the UCD tendency of ideas from UCD by the target users. Questionnaires were used to collect the responses from the target users. The ideas were grouped randomly as two sets; one group was the UCD design and the other was the non-UCD design. Each set consisted of many ideas from either the UCD process or the non-UCD process. The paired T-test was applied to compare the values of the means from the two related samples; for example, in a 'before and after' scenario. In this case, the paired T-test was used to compare the performance of the design practitioners, both before and after using the proposed UCD model. A paired T-test replied on the assumption that the two sets of data were both of normal distribution.

SPSS (Statistical Product and Service Solutions) is a statistical software package which is popularly used to analyse quantitative research. It was first released in 1968 after being developed by Norman H. Nie, Dale H. Bent and C. Hadlai Hull. SPSS provides many built in statistical methods and can create a report quickly (see Figure 29), including the paired T-test function used in this research.

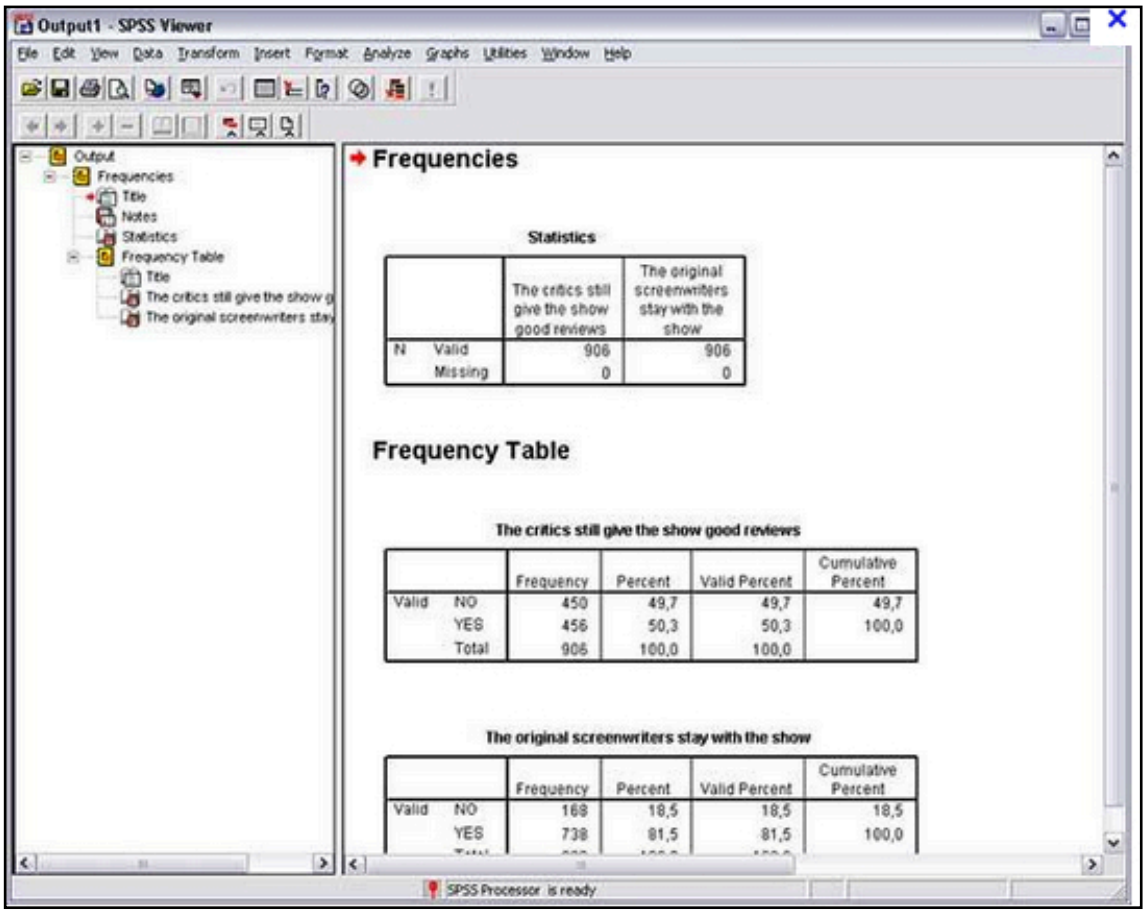


Figure 30 A Report View of the SPSS software

In this section, methods were reviewed that will be applied in later chapters. The methodology structures this research with a scientific procedure. The questions were defined in order to ascertain the research problems. Later, mixed methods were used to construct the solutions step by step. TAP, contextual inquiries, interviews and observations were mixed and used in order to gain the best performance for each assessment. In addition, they are all UCD methods. In the last section, the research methodology was concluded for this thesis.

2.6. Conclusion

In this chapter, idea generation was discussed and its scope defined for the whole design process, starting from the opportunity specification to the product specification. At this stage, designers play the main roles. UCD is applied to the structure of this thesis, which consists of a complete theory from the philosophy to its practical approaches and the design process. It is also supported by the ISO

standard ISO 9241:210. The standard ISO 9241 (210) also defines the term ‘User Experience’ (UX), and can be recognised as the evolutionary version of UCD.

UCD seems powerful and it should be straightforward to assume that it is very popular, unless there is a gap between idealism and reality. It is interesting to know how design practitioners conduct a design, and to know if they are user-centred and why.

In the review of conventional UCD approaches, all have provided detailed guidelines. However, the review has also shown that the weakness of UCD seems to be the enormity of the task and price constraints. It is worth studying whether UCD can be conducted in design, whether in a big company, a small company, a budget-limited company, or in a different product design lifecycle. If the answer is negative, is there a solution to tackle the problems?

There are also reviews of the methods related to this research. The proposed methods were later pointed out, including the assessment task and the data analysis, which formed the basis of the methodology of the primary studies.

This chapter has provided sufficient information for the background in the area of idea generation, UCD/UXD, personas, service design and application software.

3. The investigation of current product design status in UCD idea generation

3.1. Introduction

The literature review indicated the benefits in practicing user-centred design, and the multitude of approaches. However, UCD is not as popular as it should be. Based on the assumption that user-centred design is useful, it can, therefore, be hypothesised that: design practitioners have problems with practicing UCD or they do not use UCD. Therefore in this chapter, assessments have been designed in order to verify this hypothesis and to explore the reasons for the difficulties in practicing UCD in idea generation in order to take forward the proposed solutions in subsequent chapters.

As a result, the first part identifies the problems of idea generation in current design work. It looks at the current status of UCD usage and asks 'why is current design not user centred?' Also, this part further identifies the problems and weaknesses of idea generation in present design work. The second part ascertains the usage of UCD in idea generation and explores the difficulties of practice. In this assessment, designers with an industrial design background were invited to take part in the test. The whole evaluation process took about 30 minutes. A portable device for personal use was selected and specified as the experimental task, namely a 'MP3 player for the group: 25-34 office female workers'.

During this process, semi-structured interviews were undertaken in order to acquire details of the interviewees' background. In addition, think-aloud protocols (TAP) were applied in which the users were asked to say whatever they were thinking, doing and feeling as they underwent their task. Furthermore, technique 'observations' were made in order to analyse the design tasks. In addition, the author used NVivo and the efficient coding method to analyse the qualitative results, which were found to be useful in finding a pattern from the designers during idea generation.

In this chapter, the hypothesis is successfully assessed; design practitioners have problems with UCD in idea generation. Consequently, this is why UCD is not as

popular as it should be and why idea generation in design work becomes very distractive for the users.

3.2. Methodology

Aims

The aim of this chapter is to investigate the current UCD design status in idea generation in order to ascertain the difficulties, and examine why designers do not use user-centred approaches?

Objectives

Based on the aims above, the objectives are

- To investigate how product design practitioners undertake idea generation in their current design work in order to assess if current design work is user-centred
- To investigate the usage of UCD in idea generation in order to identify problems in UCD idea generation
- To provide future recommendations and research limitations

Methods

This process consisted of three stages. The first was the interview stage, and semi-structured interviews were used to investigate the participants' backgrounds and their knowledge of user-centred design. A video recording was used for the convenience of further analysis. This stage took each participant 5-10 minutes of work to complete.

The second stage was the design work assessment. Considering the period of the assessment process and the number of participants, the assessment took 10-15 minutes of design work for idea generation. Think-aloud methods and observations were conducted to collect the data.

The third stage was the data analysis. To better interpret the results, Nvivo was used to transfer the data obtained into a useful pattern using a coding process. The overall methodology is summarised as figure 29.

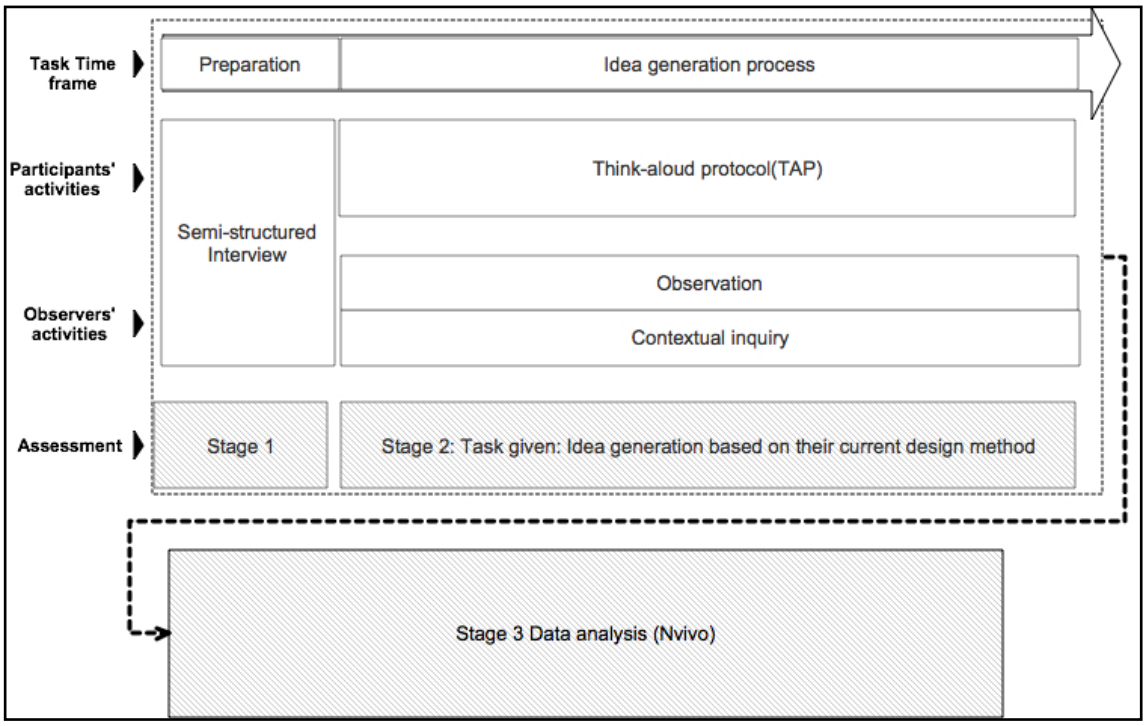


Figure 31 The assessment procedure

Participant selection and the design task

This research focused on the whole process of idea generation and, to be more specific, it is after a market segment and a definition of the product specification. The reason is that most designers and design firms have different definitions of a designers' job but idea generation is involved in various degrees in most designers' work.

Participants who were currently practicing design or who would practice design in the near future were invited to take part in this test. There was also further interest to explore whether the design experience affects UCD and, therefore, some questions related to the designers' background were asked.

In addition, in some of the design work, the designers worked as a team instead of working individually. Even in some larger enterprises, each piece of design work may be small as part of a bigger project. In the participant selection, only design practitioners who usually work as individuals were selected and idea generation was a part of their work.

In the interview session, the main aim was to obtain answers from the participants

on whether or not their design process was UCD. In the second part, a task was given to examine the outcome of the difficulties when practicing UCD. The task aimed to investigate whether the current design work was UCD and, therefore, the design product was carefully selected. A portable personal device was specified as it has some of the simplest user-factors and is a one-to-one device, unlike other products, such as home appliances, where multiple users could be considered.

Furthermore, the scenario of the product use was not defined and the participants needed to consider the context of use in their task. Additionally, the design task covered both aesthetics and functionality since both of them were factors that could affect users accordingly, as Norman (emotional design) suggested. Therefore, the task was defined as below (Table 2)

Table 2 Task design

Product	Musical playback device (MP3)
Product vs. users	One-to one device
Users/market segment	25-34 female workers
Context of use	Portable device, not restricted to a specific place

In this process, a task was given for all participants, which was to use the conditions provided to plan the product specifications. Consequently, the environment was set up as per figure 30. Participants were able to use blank paper for sketches, and a PC with Internet access was made available for them to browse related works. The environment aimed to make participants design in the same way as their usual design behaviour.

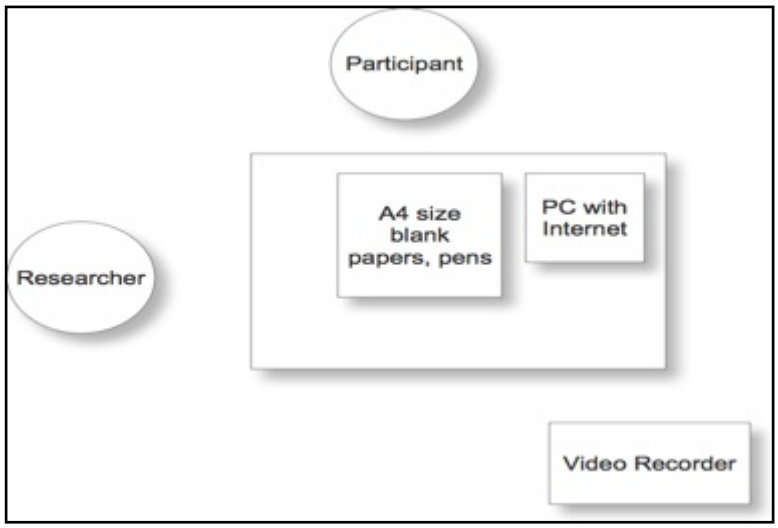


Figure 32 The layout for the assessment

3.3. Results and discussions

There were 20 participants in this assessment, all from the product design field. The participants included design students, junior designers (work experience equal to or less than three years) and senior designers (work experience greater than three years). The total assessment took around 20-30 minutes for each participant.

Interview process

In the interview process, there were several main questions asked in the semi-structured interviews, and an understanding of the participant's background was used to find any indication of whether the idea generation was impacted by the factors listed above. NVivo was used as the tool to transcribe and code the information.

N-vivo is a qualitative tool used to organise the results and facilitate the result analysis by coding. Because the interview was prepared as semi-structured, there were specific questions and answers expected from this process. In this research, those questions were then coded, as described in table 3.

Table 3 Codes of user's design context

Codes	Description
Academic_ background	To understand the academic background of participants
Design_ experience	To understand the participant's design experience

Job_ function	To understand the participant's job function in their design experience
Project_ lifecycle	To understand the participant's project lifecycle in most design cases
UCD_ in_ design	To understand if the designers conduct user-centred design

Thirteen of the participants were from Asia, six of them were from Europe and one was from the US. As can be seen from table (), industrial designers were interviewed in the first and second phases. Within the group, there were thirteen senior designers with more than five years of work experience. Five of the group were junior designers with between six months and five years experience. The final group member was a senior design student who had only run independent design projects and group projects. However, six of the designers felt that they needed to study the market on their own before they designed.

As mentioned, one of the objectives of the research in this chapter was to survey the designers' current design work and its relationship to UCD. Therefore, the crucial results from the interviews meant it was possible to understand whether designer practitioners conducted UCD in their work. However, there were some other research interests in these interviews, such as whether the factors of academic background, job function and project lifecycle are relevant to user-centred design.

Regarding the main aim, to ascertain whether participants' designs are user centred, nine out of 20 participants said they considered the users in their design. Half of them also expressed that the design should cover as many users as possible. Only one of them thought that users were not a concern in the design process.

The results showed that almost half of the participants had conducted user-centred design and this was reflected in the fact that user-centred design is not popular.

A further analysis was undertaken into the backgrounds of the participants in relation to the user-centred design. There was no clear pattern to support the

relationship between work experience and UCD. In addition, most of the participants were invited to graduate from the design school. Not much information indicated the trend of whether current design education helps the use of UCD, compared with the participant who does not have a formal design education. However, one thing that was confirmed from the result is that current design education does not encourage design practitioners to conduct UCD since only nine out of 20 thought that UCD matters in design practice.

In addition, the data showed that most of the participants had similar job activities but that some of them covered more of the front-end of marketing or market research. However, there was also no sign that participants who were involved in market research considered the users more than those participants whose jobs were dedicated to design work. The overall results are organised in table 4.

Table 4 The results from the task execution: the process of idea generation

No.	Design Tendency	Colour Scheme	Form	Special Functions?	Style/Tactile	Note
1	Product Centred	Blue	Simple look, like an iPod	Wi-Fi/ Convenient	Fashion	Design Tendency: To observe and analyse the respondents 'design behaviour. 1.Product Centred: Designer cares about the shape more than about the users 2. Designer Centred: Designers regard themselves as the users when approaching the design 3. Designer Centred + *UCD The designers design using UCD, but after a few minutes, they become designer-centred. The researcher asked them why they changed, given this element However, they can then realise they are designer-centred after the researcher asked 'is this element for 25-34 year-old office ladies?' 4. *User centred: Participants place the user in their design considerations but easily get distracted
2	Designer Centred + *UCD	White with some pattern	Not specified	Not specified	Organic	
3	Designer Centred	Red or Pink	Sweet/ Stylish	Not Specified	Feminine and Elegant	
4	Product Centred	Cannot decide now	Not specified	Simple MP3	Feminine	
5	Designer Centred	Black, to cover a wider variety of users	Smooth/ Technology like	Sound quality/Easy to play	Shiny surface to fit current trends	
6	Product Centred	Pink series or multi- coloured mix	Round/ Delicate/ Match the dress	Simple keys	Elegant	
7	Designer Centred + *UCD	Soft colour, such as pink or white	Accessories	Friendly interface.	Plastic but with metallic look	
8	Product Centred	Red/Pink	Looks like a Lipstick	Simple buttons to operate	Shiny Plastic	
9	Designer Centred + *UCD	Feel happy/pink series	Simple/Neat/ Accessories	Easy interface and easy to charge	Delicate/ Fashionable	
10	* UCD	Many colours for selection, such as red/pink series	Simple/Clear	Can be used on the bus	Metallic	
11	Product Centred	White series/ Shiny bright series/Pink series	Round/ Friendly/ Slim/Neat/ Easy to carry	Easy interface/ /Shortcut to save files/ Rapid wireless to download albums	Rubber / Leather (Soft feeling)	
12	Designer Centred +*UCD	Silver +Black	Simple	Internet /Plug and Play and auto sorting	Metallic +Plastic	
13	Designer Centred	Cannot decide now (Multiple selections)	Simple like an iPod/ Square	Easy key/Touch panel	Plastic but metallic feeling	
14	Designer Centred + *UCD	Pink/Feminine colour	Accessories to match the	Bluetooth/Can have a mirror	Shiny/Plastic	

			handbag			(They can be UCD after the researcher asked them 'why did they include this element?')
15	*UCD	Light pink	Curved	Not important	Comfortable	
16	Product Centred	Silver and +Green	Rectangular	DAB, Recorder/Subwoofer /Camera/Digital frame/ Lighter	Metallic and+ plastic	
17	*UCD	Luxurious/Elegant	Smooth	Simple	Soft/ Comfortable	
18	Designer Centred + *UCD	Simple	Simple	Easy to share with friends/Easy to download	Not specified	
19	*UCD	Fashion colour	Shaped like perfume/ Accessories	Not specified	Feminine	
20	*UCD	Bright colour/Yellow	Round /Funny shape	Earphones match the mp3	Cute/Plastic	

Assessment of the difficulties of UCD

The researcher was required to observe the participants while they were doing their design. Additionally, a think-aloud method was applied to the whole process. After the results were organised and analysed, they were transcribed and listed as table 4. In the table, A means 'the participant took users into their design consideration'; B means 'the participant considered product sales rather than just focusing on users'; and C means that the 'user is not the main consideration'.

In the interview session, the participants were interviewed to see if they considered users in their design, and here, as can be seen from the table above, only five out of 20 participants used UCD. UCD is defined as 'participants put the users in their design considerations but easily get distracted'. (They could be using UCD when the researchers asked them 'why did you include this element?')

According to the definition above, even if the participants' design tendencies were grouped as 'UCD', they were still not very UCD. In addition, comparing the data when asked "Do you consider UCD in your design work?" and the design tendency from the task, it can be seen from Table 5 that even though the participants were in favour of UCD, in their real design work, the rate of UCD practice was even lower. This shows that even if participants are aware of the importance of considering users in the design process, UCD is, however, very difficult to approach. Figure 31 shows that UCD usage was only a quarter (five out of twenty) in this assessment. Following the conclusion from the interview session, that 'UCD is not as popular as it should be', in the task session, the result showed that even though participants were willing to use user-centred design, there were several barriers that stopped

them from realising UCD completely.

Table 5 UCD tendency from the design participants' view and from the observer's view

Participants	Participants' view of their design performance: they take users into their design consideration during idea generation	Observer's view: Participants design tendency To observe the respondents' design behaviour
1	B (considers product sales rather than just focusing on users)	Product Centred
2	B (considers product sales rather than just focusing on users)	Designer Centred + *UCD
3	A (takes users into their design consideration)	Designer Centred
4	A (takes users into their design consideration)	Product Centred
5	B (considers product sales rather than just focusing on users)	Designer Centred
6	C (user is not the main consideration)	Product Centred
7	B (considers product sales rather than just focusing on users)	Designer Centred + *UCD
8	B (considers product sales rather than just focusing on users)	Product Centred
9	B (considers product sales rather than just focusing on users)	Designer Centred + *UCD
10	A (takes users into their design consideration)	* UCD
11	B (considers product sales rather than just focusing on users)	Product Centred
12	A (takes users into their design consideration)	Designer Centred +*UCD
13	B (considers product sales rather than just focusing on users)	Designer Centred
14	A (takes users into their design consideration)	Designer Centred + *UCD
15	A (takes users into their design consideration)	*UCD
16	B (considers product sales rather than just focusing on users)	Product Centred
17	A (takes users into their design consideration)	*UCD
18	A (takes users into their design consideration)	Designer Centred + *UCD
19	A (takes users into their design consideration)	*UCD
20	B (considers product sales rather than just focusing on users)	*UCD

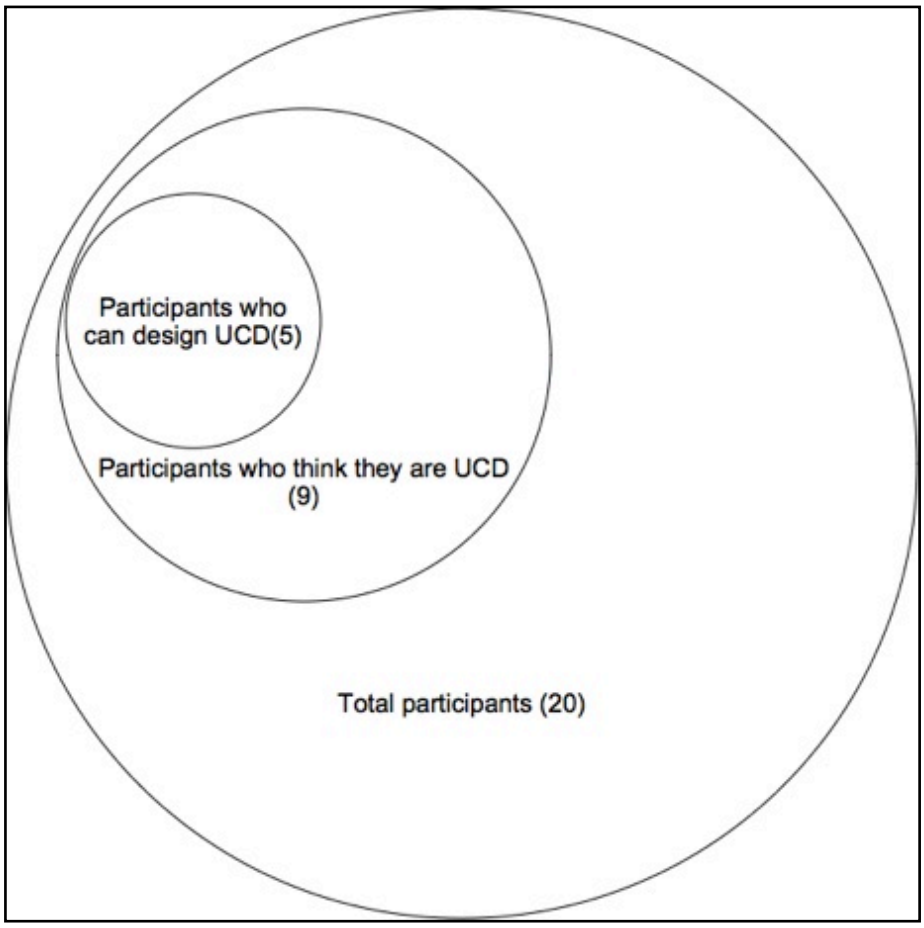


Figure 33 UCD observation status

- **Summary of the difficulties of practicing UCD**

When analysing the whole process, the difficulties of practicing UCD can be summarised:

1. Participants think that UCD is not compulsory in design. Only nine out of 20 participants regard UCD as their design principal.
2. Participants have an incorrect design strategy and expectation. If users are not the main concern in the design, it is hard to ensure that the product can satisfy its users. Therefore, this is unlikely to lead to many product sales. In other words, if a small group of users is not satisfied, it is unlikely to cover a wider range of users.
3. There is also the possibility that UCD is well known by design researchers but not known by design practitioners. This may also be reflected in the fact that design researchers and design practitioners usually have different

skills.

4. When working with UCD, but without a systematic method, it is very easy to become distracted. In this observation, there were five participants who could be UCD after being asked, ‘Do you think you have considered the users?’ by the researcher in the think-aloud process. Most of the time, participants will regard themselves as users until the researcher questions them. Additionally, after they view related work or are inspired by other materials, they sometimes get distracted from their work.
5. None of them had heard of the UCD approaches reviewed in the literature review, and none of them could practice UCD using other UCD approaches, such as PD, CD, ED and personas. This might be a similar reason to item 3, in that product design practitioners are not familiar with the methods of design research.

3.4. Conclusions, research limitations and future recommendations

Conclusions

This research successfully proved the hypothesis: ‘UCD is supposed to be popular due to the fact it is a very important design discipline. However, in the real world, the usage of UCD is not very popular’. Additionally, difficulties were found. For instance, design practitioners do not regard UCD as a ‘must’ principle; design practitioners are not design researchers and, therefore, none of them have learnt to use UCD methods; a lack of systematic UCD methods was suggested to the design practitioners, implying that UCD work can easily become distractive.

Research limitations

1. In the whole task, participants were only given around 10-15 minutes to develop their ideas and this is far less than the usual time they have. Even when the participants were asked the question, ‘Do they think of the user themselves without being questioned?”, most participants thought that, most of the time, this task was similar to their project, and that having more time would not help much with UCD. However, it was still possible, if more time was given, that some participants may think more of the users later in the

process.

2. In the task practice, an attempt was made to provide as many resources as possible, as participants usually use these in their design behaviour for idea generation. However, a PC with Internet accessibility may not be able to replace magazines or books. This may reduce the participants' design performance.

4. The construction of a UCD model for idea generation

4.1. Introduction

UCD is widely regarded as a design philosophy, and it can solve many design problems. However, chapter 4 has shown that UCD is not as popular as it should be. Problems in current UCD approaches are addressed, as they are very complex, time-consuming and costly (Chen et al., 2009). In addition, in chapter 3, it was proven that practicing UCD idea generation encompasses many problems for design practitioners. Some more supported results from the last chapter also indicated the difficulties of practicing UCD.

This chapter aims to provide a theoretical UCD model to encourage more UCD usage. Therefore, resolving the problems of distraction from users, as well as an easy to apply system for idea generation by design practitioners, should be considered as a high priority during the model's development. Consequently, a persona-based model within an empathic design concept has been proposed and this has been further evaluated by design practitioners. In this concept, the conventional UCD in idea generation can be divided into two areas: user research and design practice.

Personas are used as 'virtual users' and, therefore, this is more cost effective and favoured by design practitioners or small design companies. In addition, by using virtual users, it does not limit designers current work behaviour. This may help to encourage the use of more UCD from those who have never practiced UCD before.

This research will first interview design practitioners regarding the use of personas in order to investigate how much they know about personas. A small task is then given to them to practice with and without personas. The user-centred tendencies will also be observed to see if there is a degree of improvement from the use of the personas and a theoretical UCD model based on the personas will be built. In the second stage, the proposed model is evaluated by design experts in order to refine the model.

4.2. Methodology

Aims

The aim of this chapter is to create a design process evaluation task for product designers in order to construct a UCD model for idea generation.

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Objectives

1. To propose personas and empathic thinking based on the problems found in chapter 3
2. To investigate how product design practitioners interact with these personas.
3. To further refine this persona-based model with an expert review in order to help design practitioners with their idea generation
4. Future recommendations and research limitations

Methods

The process consists of several stages based on the objectives above, and the overall methodology is, therefore, suggested as per figure 33.

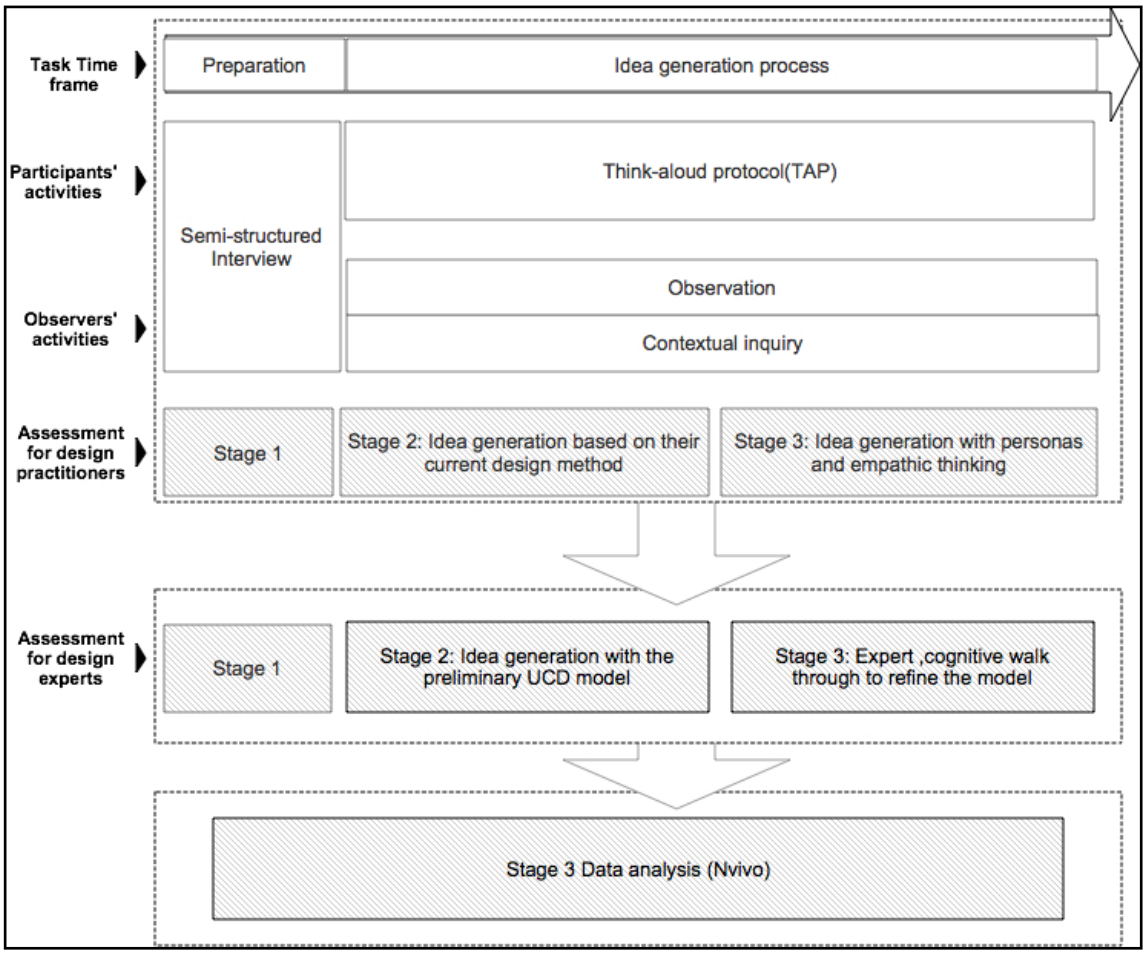

Figure 34 The assessment flow

The first stage is the design work assessment. Design practitioners were asked to develop their idea using the methods they prefer. Considering the period of the assessment process and the number of participants, there had 10-15 minutes for idea generation in the design work. The think-aloud method together with observations and contextual inquiries were conducted to collect the data.

The second stage is the design work assessment with the assigned personas and the empathic thinking. In the instruction, the design practitioners were asked to interact with the personas assigned to them, and they needed to review each idea with the personas. Considering the period of the assessment process and the number of participants, only 10-15 minutes was given for the idea generation in the design work together with one persona.

After the first two stages of the design work, the participants were each asked to complete a questionnaire in order to evaluate their satisfaction of the use of the

persona method.

The next stage was to refine the model by inviting design experts to evaluate the proposed model. During this expert review, the design task and the cognitive walk through process were assessed.

The last stage was the data analysis. To better interpret the results, Nvivo was used to transfer the data into a useful pattern using its coding process.

Participant selection and the task design

Design practitioners were selected as the participants. Because the work is continued from the previous chapter regarding the exploration of the current methods of idea generation, the participant selection is identical to the previous chapter, i.e. design practitioners whose work involves idea generation. During the idea generation process using adaptations of the personas, participants were asked to read a ready-made persona whose profile was located in the range of the target users: 25-34 female office workers.
The process of creating a persona has several considerations. The literature shows that a person should at least consist of a photo and a profile. In addition (Microsoft book) it is also suggested the most use of the attributes in the profiles. Therefore, a basic person with a photo, name, demographic and geographic profiles, and activities related to the products, is used to build a lifelike character with details of her personality.

The persona should be developed from an anthropological survey, except for the name and the photo, according to the previous literature. This is to avoid stereotyping a persona with a familiar name and photo. Additionally, for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos from the FERET[*(1)] database (Figure 34).

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*1: The FERET programme ran from 1993 to 1997. Sponsored by the Department of Defence Counterdrug Technology Development Programme through the Defence Advanced Research Products Agency (DARPA), its primary mission was to develop automatic face recognition capabilities that could be employed to assist security, intelligence and law enforcement personnel in the performance of their duties. It was used in this research to provide photos

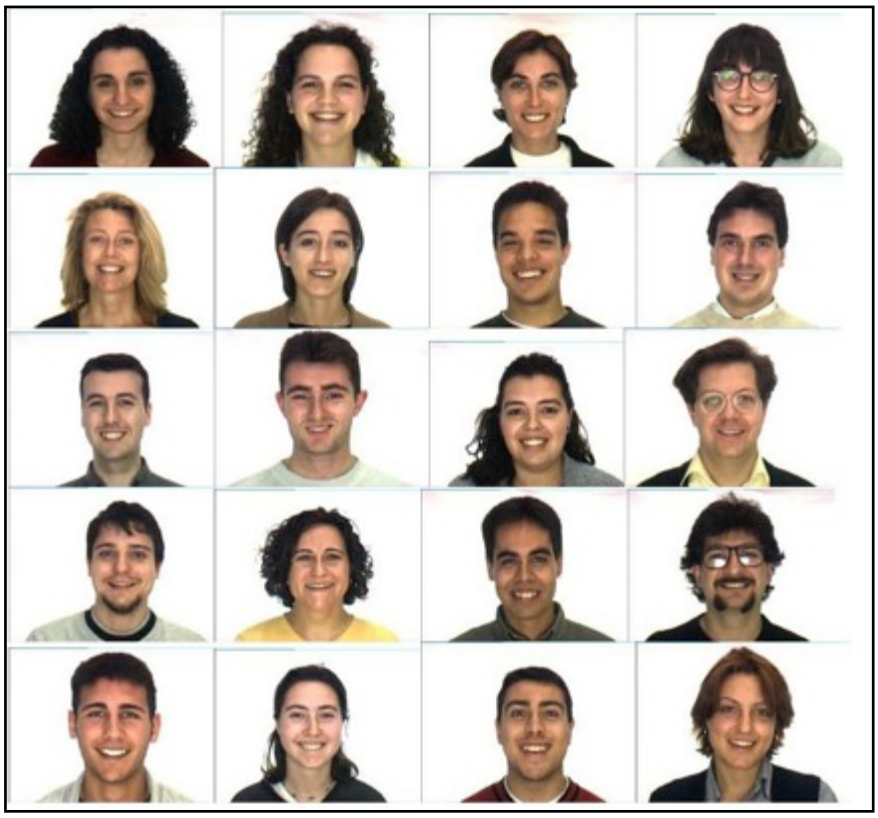

Figure 35 Photos from the FERET database

Table 6 The frequency of profile use

Basic Details		Job/Work information	
Name	90%	Typical Activities	92%
Photo/Illustration	71%	Job Title	84%
Personal Information		Goals	81%
Age	84%	Job Description	74%
Fears/Obstacle	75%	Company/Industry	65%
Motivations	67%	Challenge Areas/Breakdowns	61%
City/State/Country	61%	Interaction with Colleagues	61%
Technology Access and Usage		Work Style	61%
Technology Opinion/Attitude	68%	Others	
ISP/Connection Speed	83%	Relationship to your product	83%

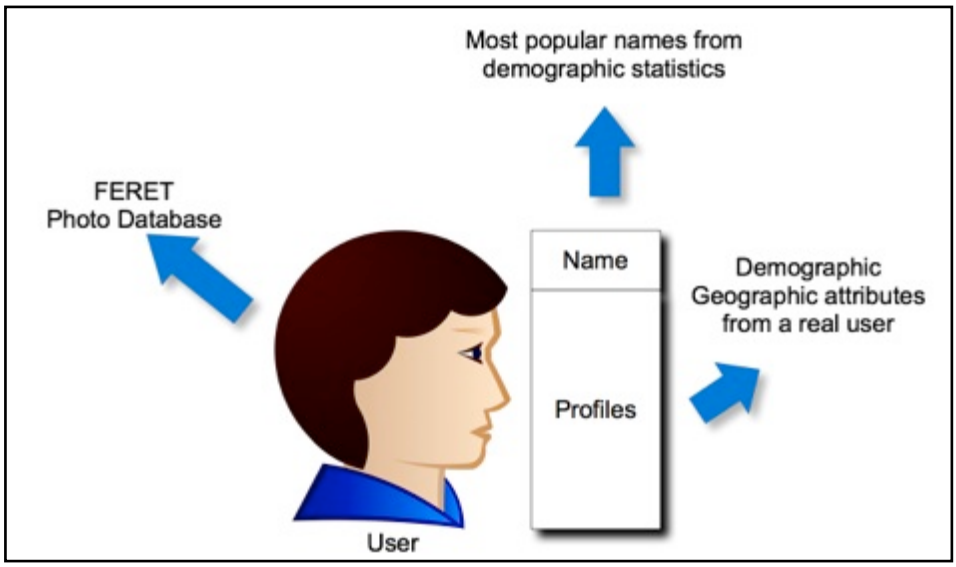

Figure 36 Demonstration of database category

Figure 37 An example of a persona

The names were chosen from the most popular names on the website [*2]. The profile of the persona was taken from a lady who was located in the target market segment.

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*2 The official website of the U.S. Social Security Administration (http://www.ssa.gov/oact/babynames/)

The task given was to explore the process of idea generation between the methods the designers prefer to use and the persona method. The task aims to test if the current design is UCD and how much the personas can improve it in order to conclude a suitable UCD model. Therefore, the designed product, a portable personal device, was carefully selected. It has the simplest user-factors, and is a one-to-one device, unlike other products, such as home appliances, where multi-users need to be considered. Furthermore, the scenario of the product usage was not defined; the participants needed to consider the context of use in their task. In addition, the design task had to cover both aesthetics and functionality since both of them are factors that they will affect users accordingly, as Norman (emotional design) suggested. Therefore, the task is defined below in table 7.

Table 7 The task assigned in the assessment

Product	Musical playback device (MP3)
Product vs. users	One-to one device
Users/market segment	25-34 year old female workers
Context of use	Portable device, not restricted to a specific place

In this process, a task was given for all participants, which was to use the conditions provided to start their idea generation. The environment set up is as figure 37. Participants were able to use blank paper for sketches, and a PC with Internet access was available for them to browse related works. The environment was aimed at encouraging the participants to design using their normal design behaviour.

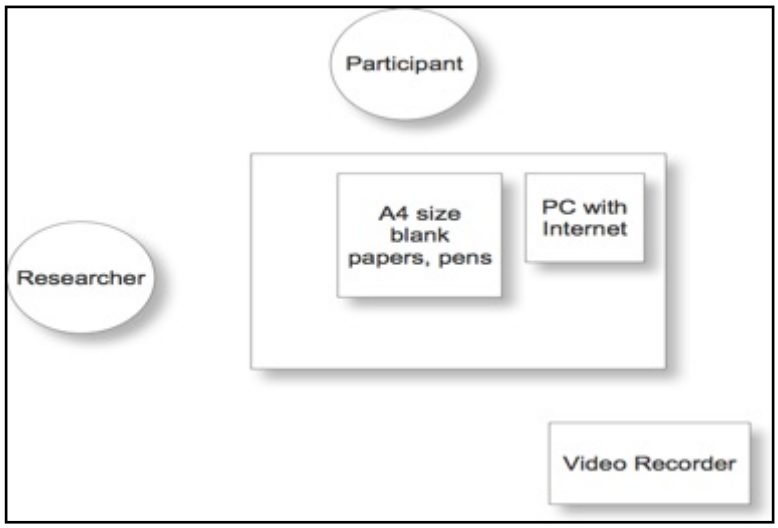

Figure 38 A demonstration of the assessment layout

4.3. Results and Discussion

There were 20 participants in this assessment. The participants included design students, junior designers (work experience equal or less than three years) and senior designers (work experience greater than three years). The total assessment time was approximately 20-30 minutes.

Exploration of the use of personas in idea generation

In Chapter 4, the results were gathered and it was found that design practitioners employed their preferred methods in idea generation. The results were used in this chapter as comparisons to evaluate the use of the personas.

When participants were asked to develop their ideas using the persona, participants needed to design the product to fit the needs of the character. Questions were often asked when they were generating their idea, such as ‘are you designing for this user now?’, and ‘do you think this user will like this idea?’ Interestingly, it was soon discovered that participants were very quick to give their ideas and they seemed very focused compared with the stage when they were designing using their own methods.

Table 8 has shown how the designers developed their product concept. As can be seen, seven of them were product-centred, which means the designer only considered the shape, and disregarded the user. Three of the designers tended to

be designer-centred with five tending to be both designer-centred and user-centred. Finally, five of the designers were UCD but were easily distracted.

When analysing the interview results, it was found that one of the weaknesses of the designers' present work is that, regardless of their experience, there was less user-centred design. When examining the status of the user-centred designers, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another issue was that most designers were concerned with the design shape rather than a functional design. Hence, it can be suggested that the designers, without the support from a user research team, tended to ignore the users in their design.

As shown in Table 8, and from the interviews and observations, the designers were able to explore more design ideas. Additionally, it was found that the participants made quicker design decisions. There might, however, be some errors attributed to the training effect, due to the same product for the same users being assigned to the same users twice. Nevertheless, the supportive point from the interviews was that three of them had done the MP3 project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when the participants were asked whether they felt the later concepts they made contradicted the previous task. All of those designers who were designer-centred and product-centred felt that the later designs were more likely to be suitable for 24-35 year-old female office workers. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour domain to red.

Nevertheless, the participants highlighted various concerns, which included the fact that the use of personas may make the product too personal and cause failure in a market approach. Also, personas are difficult to create. Moreover, participants were concerned that using only one persona may narrow the market and that may create biased decisions. After more personas were provided for them to select from, they

all felt satisfied and their worry towards the misrepresentation of the personas was eliminated.

Table 8 Results: idea generation

No.	Colour Scheme	Form	Special Functions?	Style/Tactile
1	Blue	Simple look like an iPod	Wi-Fi/ Convenient	Fashion
2	White with some pattern	Not specified	Not specified	Organic
3	Red or Pink	Sweet/ Stylish	Not Specified	Feminine and Elegant
4	Cannot decide now	Not specified	Simple MP3	Feminine
5	Black, to cover a wider variety of users	Smooth/ Technological	Sound quality/Easy to play	Shiny surface for acceptance by the market
6	Pink series or multi- coloured mix	Round/ Delicate/ Match dress	Simple keys	Elegant
7	Soft colour such as pink or white	Accessories	Friendly interface.	Plastic but with metallic look alike
8	Red/Pink	Lipstick look alike	Simple Buttons to operate	Shiny Plastic
9	Feel happy/pink series	Simple/Neat/ Accessories	Easy interface and easy to charge up	Delicate/ Fashion
10	Many colours for selections such as red/pink series	Simple/Clear	Can be used on the bus	Metallic
11	White series/ Shiny bright series/Pink series	Round/ Friendly/ Slim/Neat/ Easy to carry	Easy interface/ /Shortcut to save files/ Rapid wireless to download albums	Rubber / Leather (Soft feeling)
12	Silver + Black	Simple	Internet /Plug and Play and auto sorting	Metallic + Plastic
13	Cannot decide now (Many multiple selections)	Simple like an iPod/ Square	Easy key/ Touch panel	Plastic but metallic feeling
14	Pink/Feminine colour	Accessories to match the handbag	Bluetooth/ Can have a mirror	Shiny/ Plastic
15	Light pink	Curved	Not important	Comfortable
16	Silver and + Green	Rectangular	DAB, Recorder/Subwoofer /Camera/Digital frame/ Lighter	Metallic and + plastic
17	Luxurious/ Elegant	Smooth	Simple	Soft/ Comfortable
18	Simple	Simple	Easy to share with friends/ Easy download	Not specified
19	Fashion colour	Shaped like perfume/ Accessories	Not specified	Feminine
20	Bright colour/ Yellow	Round / Funny shape like	Earphones match the MP mp3	Cute/ Plastic

Table 9 The design behaviour of the participants using the personas.

No.	Colour Scheme	Form	Special Functions?	Style/Tactile
1	White	Like a T-shirt	Wi-Fi/ Convenient	Fabric feeling material

2	Red	Rectangular/ small	Agenda/ Reminder/ Schedule/ Inspired quote to cheer up her mood	Plastic
3	White	Organic	The share functions with friends	Some pattern on the plastic
4	Monotone/Simple	Rectangular/ Bigger Screen but lightweight	Touch panel/ Reminder/ Easy operation/ Music Download /Share	Soft Surface
5	White	Smooth/ portable	Easy/ Good sound/ Enough music storage	Shiny Surface
6	White	Round	Play/ Radio	Plastic
7	Pink	Cosmetic box	Easy keys	Shiny Plastic
8	Pink	Lipstick	Simple play Earphone design like earrings	Plastic/ Look elegant
9	Cute Pink	Small/ Portable/ Rectangular	Update files easily	Fashionable/ Leather
10	Red/Black	Simple	As simple as it can	Simple/ Elegant to look like professional/Metallic hair silky
11	Light bright colour	Round smooth/ Square	MP3/Recorder/ Calories measurement	Shiny plastic/ metallic like
12	High contrast colour with grey	Round smooth/ Square	MP3/Photo viewer Internet friendly/ Upload download friendly	Soft material
13	Pinky white with some flower pattern	Round smooth/ Square	Easy button with big touch screen/Photo Viewer/Sharing function	Shiny plastic
14	White with pink	Round smooth/ Square with curve for easier handheld	News/ Music downloader from the Internet	Soft in the back side for easy grasp/ Shiny mirror screen
15	White with pink blue/ red/ orange /purple	Sportive	Calories calculation Changeable cases for different moods	Soft material
16	Pink brown	Simple neat square	Small games to kill time	Soft material
17	White with Silver	Simple neat square	Simple	Comfortable
18	Light/Soft colour	Lightweight smooth square	Easy to keep notes	Not easy to get dirty/ shiny plastic
19	Red with black	Rectangular with feminine curves	Contact detail/reminder/ Photo viewer	Shiny plastic
20	Pink	Organic/ Interesting form	Can share music and photos with friend	Soft plastic

Forming a UCD model

After the assessment above, several important ideas were concluded:

- The UCD method in this model needs to be easy to use.

- Using the personas with empathic skills to generate ideas seems achievable as this method does not have the drawback of users' physical involvement as mentioned in the literature review.
- Use more than one persona to make idea priority and decisions to remove the confliction. Also, as suggested in Grudin and Pruitt's (2005) book, the maximum number of personas should not exceed five to avoid any distraction.
- The sequence between idea generation and providing personas is important
- The personas can be used within the designers' present design work.

As can be seen in Figure 38, the model is concluded from the previous phases, with these points, as follows:

1. Designers current design methods/tools are kept to ensure the current design changes as little as possible.
2. To employ personas as the basis when constructing their product concepts.
3. Multi-personas are used to eliminate the bias of using only one persona.
4. The personas can be used within their present design work.

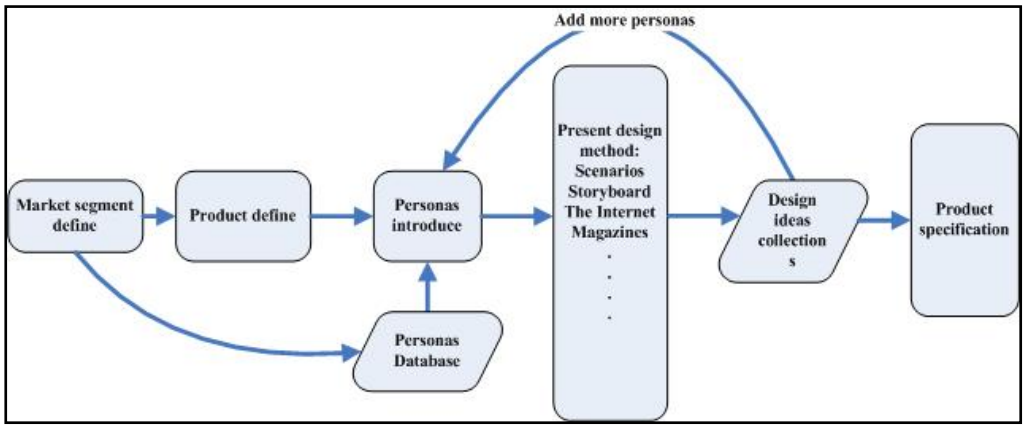

Figure 39 Forming the UCD model – the preliminary version

After the evaluation by the five designer experts, the following comments were given:

1. The model was found to be systematic, but needs training and time to practise.
2. The personas help with the decision-making, and after specifying the

personas, the ideas are narrowed.

3. Designers can be inspired by the information that comes from using the personas but too many personas make the ideas more diverse.
4. Designers found it difficult to build a persona and suggested the researchers develop a software application to help with this work.

The refinement of the UCD model

The model was modified following the suggestions made by the senior designers. Figure 39 demonstrates the flow from the given product task to the specifications of the end product.

The detailed guidelines are as follows:

- After the project is defined, the stakeholder can introduce the personas into the design work in order to create personas.
- A persona database or putting personas into the database is the territory of the user researcher, and this can be excluded from the design practitioners' work.
- The personas are located within the market segment and the subsequent whole design process.
- Cooperation with the present design tools: Most designers have their own favourite way to assist with their idea generation. The personas do not seem to conflict with most known design tools following the assessment. Instead, this research suggests that designers imagine themselves as the personas and, within various scenarios, interact with the tools they use.
- After collection of the design ideas, the stakeholder may face two difficulties. Firstly, they may worry that the use of one persona may introduce bias into the design. Additionally, focusing on the persona may lead to insufficient design ideas. This study proposes a procedure to check for this. The first is to check whether the design idea created is suitable for the persona. In other words, this check ensures the design is a user-centred design. The second is to check whether enough ideas are created or whether the designer should decide to employ more personas to complete the design

ideas.

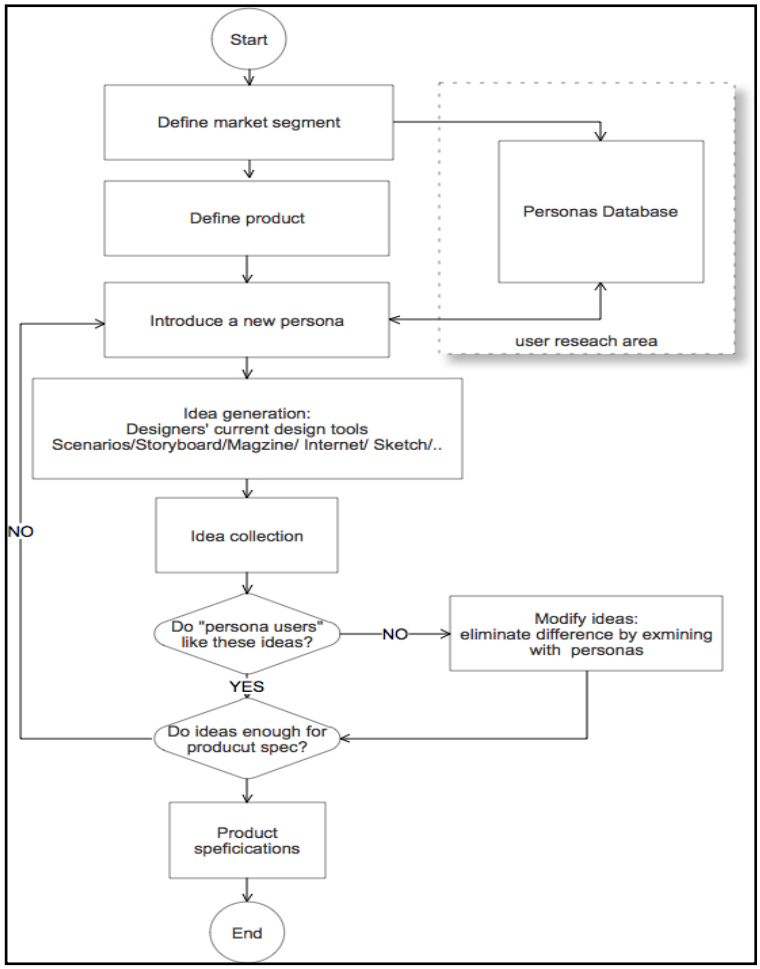

Figure 40 UCD idea generation model (Refinement)

The personas should be created in sequence. Only when the design concept for one is complete can an additional persona be created. This is to avoid the problem of too many personas used at the same time, making the design distractive again. Moreover, the experiment focused on the trend of the UCD approach. Even though the Kansai Database was not used to describe the product, it can still be observed that the design has been improved after the use of personas. Additionally, this model only evaluated a design for portable devices.

Conclusions

During this research, it was found that current design work tends to fail in relation to UCD. Nevertheless, personas can be used to reinforce UCD and can even mix with the current design tools in user research. With the assistance of the conceptual

model based on the use of personas, designers not only undertake user-centred design but are also inspired by the personas to create more design ideas. To conclude, this model can help designers integrate their users into their individual design tasks with less effort and, therefore, develop ideas that are more user-centred.

Research limitations

There were three design tasks within this research and each task took 10-15 minutes to design. The differences between the use of personas and the original work was analysed. For this research, it is still possible to see a significant difference, even when given a shorter time to complete the tasks. Although in the real world most designers spend more time on concept development, the limitation here is that the longer the experiment time, the more difficult it is to find designers to participate.

5. Evaluations of the UCD model for idea generation by both product designers and the target end-users

5.1. Introduction

The literature shows the support evidence for the use of the personas. Additionally, in previous chapters, a theoretical model based on the use of personas was created to help design practitioners to produce designs that are more user-centred. One generic question was left: Even though it can be seen that the participants pay more attention to their target users when using personas, do design practitioners show a high level of satisfaction with this UCD model? And do users feel satisfied with the ideas generated from the UCD model?

This chapter aims to assess the theoretical model created in the previous chapter in order to find out if both designers and users are favoured by the UCD model. 16 designers and 51 end-users were invited to take part in this assessment as participants in order to evaluate whether the designers who follow the proposed model can generate better UCD ideas, and if targeted users favour the ideas from the proposed model. In this project, a portable music playback device, a MP3 player, was chosen because it is portable, easy, and has both aesthetic and functionality factors. In addition, female office workers aged 25-34 were selected as the target users. The evaluations from the target-users were also tested to evaluate whether the proposed model can help designers in UCD idea generation. The result showed the ideas generated by the proposed model were more likely chosen by target users. In other words, the model provided a user-centred design guide for design practitioners. In addition, the questionnaires from the designers showed that the designers' satisfaction with this proposed model was significantly high. This research, therefore, verified a persona-based model, which can help designers work with the UCD principals.

There are several future recommendations and the design limitations are also noted at the end of this chapter.

5.2. Methodology

Aims

The aim of this study is to design an evaluation tool for product designers and target end-users in order to assess the UCD model for UCD idea generation

Objectives

Additionally, there are two main objectives of this research:

1. To launch the proposed model and compare the results from before and after the use of the proposed model. In addition, the satisfaction status from the participants using this proposed model will be surveyed by the collection of questionnaires.
2. To evaluate the effectiveness of the proposed model with preset target users: whether the UCD model can actually be user-preferred.

Based on the objectives, methods for two-phase assessments and a final UCD evaluation with pre-set target users were selected. For the first objective, an attempt was made to conduct the proposed model and compare the data after using the proposed model with the data from before. In addition, the satisfaction of the designers' was surveyed and further expert opinions were sought to refine the model. The methods selected for this were questionnaires and think-aloud protocol for the short design tasks.

The second objective was implemented from the users' vision. The results of the idea generation by designers were used to assess the pre-set target users, who are 25-34 year old female office workers.

Methods

The proposed model was empathic design with personas. As introduced in the previous sections, the empathic design focuses more on the early stages of design and could be a possible cost-effective method if the 'virtual users' are set in this proposal. With regards to the virtual users, the aim is to differentiate between other UCD approaches. In other words, the idea of 'empathic' was used to understand and think like the users instead of traditional observations from users. As a result, due to the lack of real user involvement, empathic design is a more economic approach compared to participatory design and contextual design. In addition, the personas were adapted to reinforce the existence of the users.

Based on the concept above, a persona-based model was constructed in the previous chapter. The model aimed to make personas become integrated into the designers' current work. Moreover, the use of personas and their creation was cut into two parts in order to make the proposed model more modularised in order to adjust to the sequence of workflow when needed. The model also suggested that the creation of personas was made as simple as possible since practitioners have less research background. Also, the number of personas can be acquired subject to the need of the designers. The other benefit from this model is that this model only tells designers to look at the generated personas when each idea is being generated. It does not need complex skills to manipulate. The model is shown in Figure 40.

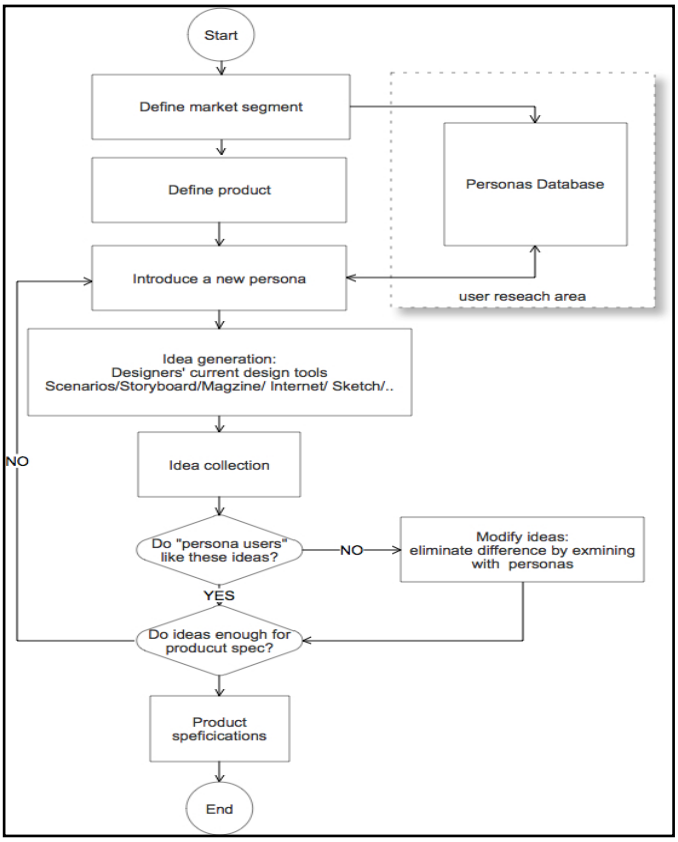

Figure 41 The demonstration of the cost-effective UCD model

Participant selection and the design task

The plan of the assessment with designers: Accordingly, a two-phase assessment was arranged with the designers and one assessment with the end-users. The purpose of the two-phase assessment was to obtain the generated ideas and compare them. Furthermore, the target users in the final evaluation will

evaluate the idea set. The illustration of the two-phase plan is shown in Figure 41.

Figure 42 The Illustration of the two-phase assessment with designers

16 designers were invited to participate in the experiments. Even though this research can be relevant to various product categories, the researchers defined several control factors in order to examine the comparable information in this experiment. Firstly, the same product was assigned in all the design tasks in which the designers were asked to develop their product concepts. Additionally, the participants were required to have a similar background and to be able to manage the development of a design concept for a single product. Moreover, the designated task was confined to designing a product for use by an individual instead of a multi-user product. Each designer-participant spent about 30 minutes taking part in the interviews and the design tasks. Additionally, the design task needed to include appearance, function and usability in order to project the three emotional layers.

The assessment chose a portable MP3 player for the group ‘female office workers aged 25-34’ as the users of the experimental task as an MP3 player is mostly for individual use. Some products, such as a remote control, are a multi-user device, and would bring more complicated factors to the research. Therefore, a personal use product was specified to simplify the use of the personas.

Assessment phase I (The investigation of the current design pattern)

This task was to ascertain whether the designers could focus on users to find out the current design status. This is as a reference for participants to compare the results and give a subjective satisfaction evaluation for assessment II.

Assessment phase II (The investigation of the use of the model)

The second phase introduces the persona-based model in order to investigate how personas can help with the design task. Before the task is examined, some

assumptions are proposed: The designers are trained to have common design skills and they are assumed to have the imagination for the operation of fictional characters. Otherwise, the participants and the target task remained the same as for the first phase.

A persona should be developed from the anthropology survey, except for the name and the photo, according to the previous literature. This is to avoid stereotyping a persona by using familiar names and photos. Additionally, for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos from the FERET database, which is usually used in face recognition. The database captures various emotions from each person. Nevertheless, in this experiment, a smiling face was used to link with the emotional design as shown in the example photos in Figure 42 (right side).

The focus of this research is the assessment of understanding designers' current work in idea generation using the persona-based model to help them easily design for users. Therefore, this paper will focus on the interaction between the designers and personas since there has been plenty of literature addressing the generation of personas. Accordingly, the literature was simply followed in order to generate a suitable persona. Olsen (2004) offered guidelines for creating personas and Pruitt and Adlin (2006) provided additional knowledge about personas in their book.

In terms of the photo, as the conditions of the tasks needed to specify the age and the gender, a photo was randomly picked from the database above. Additionally, the names were chosen from the most popular British names on the website. The profile of the persona was taken from a lady who was located in our target market segment. Due to the limited task time available, the author only assigned one persona and assumed that this lady is the archetype of this group, as the illustration on Figure 42 (left side) shows.

Task 2 took 10-15 minutes and the participants were asked to generate a design, applying the same conditions as the first phase. The only difference was that they needed to develop their concept using the specified persona provided. The persona is located within the same market segment, '25 to 34 year-old female office workers'.

Figure 43 The left side is example photos from the FERET database. The right side is the persona in this task.

The plan of the evaluation with target users

This stage aims to evaluate the effectiveness of idea generation using the proposed model. This user group (female office workers aged 25-34) is the target group for when the designers create their design during the assessment. First, the ideas were grouped into two sets; one set is the ideas generated before the use of the model and the other is the ideas after use of the proposed model. Next, 16 sets of ideas for portable MP3 players were put randomly into the options. The users were then invited to complete the online questionnaire. The last part analysed the data to see which set of ideas were more preferred by these target users.

5.3. Results and discussions

The 16 industrial designers who took part as the participants were interviewed during the first two stages. There were eleven senior designers with more than five years of work experience and the other five were junior designers with between six months and five years experience.

However, six of the designers felt that they needed to study the market on their own before they designed. Consequently, to avoid unfairness in the experiment, the task was further confined by the researcher. The same product information was provided and the participants were only asked to develop their product ideas.

Furthermore, the designers were asked to describe their current methods of practising idea generation and their general design cycle for a project. Interestingly, when the question was asked, ’Does the user matter in your design projects?’ only six of them answered ‘Yes‘, whereas nine responded that they did specify users but

tried to ensure the design covered all user groups in order to gain maximum benefits. This demonstrated the current design problems where designers were usually asked to create a design that greedily covered the market. As a result, the design seems destructive and confuses the real user group, and this phenomenon will be seen in the following design task. The final participant believed that users were not important in their design. The designers were also asked how much they understood emotional design. Surprisingly, only one of them showed an understanding. Most of them either said they had never heard of it or they had heard of it but they did not exactly understand the definition of emotional design. These patterns will be examined in the design task to see if the interview answers were identical to the designers' design behaviour.

With regards to the design behaviour, several methods were used to inspire design ideas. Most of the designers tended to get the design concept using sketches, brainstorming and information gathering. Later, they were given a design task that followed their current methods. Before doing this task, the question was asked as to whether they had designed a similar product before. Four of them had designed once for the same market segment and two of them had designed the same product. This information was taken in order to compare whether the trained-effect factor contributed towards any bias in the design process that the participants were asked to do.

One important aspect of this stage is to understand the difficulties of practising UCD. None of them said that they had not heard of the UCD principle. Additionally, amongst all these designers, none had experience of gathering real users to explore their needs and responses. They reflected that their design projects were mostly undertaken without any real user involvement. This problem was blamed on the short design schedule and the fact that no extra cost was given for them to do this kind of user research. Some other difficulties in practising UCD will be revealed in the task in which designers were asked to generate design ideas on their own.

Results from Phase I of the assessment (Before the use of the proposed model)

This part of the result showed how the designers developed their product concept

before using the proposed model. As can be seen, six of them were product-centred, which means the designer only considered the product elements to make it pretty, regardless of the user. Three of the designers tended to be designer-centred with five tending to be both designer-centred and user-centred. Finally, two of the designers were user-centred, but were easily distracted. During the assessment of this task, the designers were only asked to sketch due to the limited time and to ensure the process was consistent for every designer.

When analysing the interview results, it was found that one of the weaknesses of the designers' present work is that, regardless of their experience, there was less user-centred design. When the status of the user-centred designers was examined, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another finding was that even though two of the designers said they had undertaken emotional design before, they actually believed that 'appearance design' meant emotional design.

Another drawback was that most of the designers were concerned with the design shape rather than the functional design. Consequently, it may be surmised that the designers, without the support of a user research team, tended to ignore the users in their design.

Results from Phase II (The investigation of the use of the model)

The design task assumed the same conditions as the previous task. From interviews and observations, the designers were able to explore more design ideas. Additionally, the designers were found to use shorter timescales to make decisions. There might, however, be some errors attributed to the training effect due to the fact that the same product for the same users was assigned to the same designers twice. However, the supportive point from the interviews is that three of them had previously designed a MP3 project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when they were asked whether they felt the later concepts made contradicted the previous task. All of the designers who

were designer-centred and product-centred felt that the later designs undertaken with the persona were more likely to be suitable for 25-34 year-old female office workers. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour or a specific colour.

The designers obtained a general image of this user by the photo, name and essential profile, such as age and gender. They then made a rough appearance and used sensory design. When the designer looked at the detail, they usually narrowed down their ideas in relation to the reflective part. Furthermore, they began to get inspiration from different combinations of the details in order to provide a functional design, which is mapped to the behavioural level. However, there were no clues from the interview that they could do a visceral design using the provided personas.

In general, the participants were satisfied with the use of personas and felt surprised at the effect of them. They commented that the personas helped them to think about the users' emotions all the time without distraction. Also, they felt that this tool could help them achieve self-communication and would enable them to examine the ideas they made.

From the comparison of the task before and after the use of the persona, it can be seen that the design tendency converged to a similar colour domain with an aesthetic design. Regarding the functional design, ideas were fruitful but were still stuck regarding the users. In addition, when designers undertook the task using the persona, they tended to design quicker and concentrate more.

Furthermore, when conducting Phase II, there was an impressive finding in this experiment. This proposed method not only attained empathic design, but there was also the realisation that designers do not need to be trained for this method, even when they do not know much about the theoretical part.

Results from the evaluation with users

There were 51 online questionnaires answered, and all of these were by Taiwanese office ladies within the age range 25-34. The set of answers regarding

the ideas were separated into two categories: Proposed Model (A) vs. Original Design (B). There were also 16 sets of ideas from 16 designers who had designed before and after (the use of the proposed model). The original data from the sixteen sets are shown in Table 1.

Table 1. The votes from target users

No. of designers' idea set	Votes counted from 51 preset target users A (ideas generated by using the proposed model	Votes counted from 51 preset target users B (Original ideas)
1	28	23
2	23	28
3	38	13
4	44	17
5	37	14
6	41	10
7	44	7
8	26	15
9	14	37
10	30	21
11	15	26
12	33	18
13	25	26
14	39	13
15	33	18
16	20	31

A paired-T test was used to analyse whether the data is orientated to Group A (idea generated by using the proposed model) or Group B (original ideas). The result shows that most of the target users preferred the ideas generated by the user-centred model, as shown in Tables 2 and 3.

Table 2. Paired Sample Statistics

	Mean	N	Std Deviation	Std Error
Group A	30.25	16	9.191	2.298
Group B	19.19	16	8.758	2.189

Table 3. Paired Sample T-Test

	Paired Differences							
				95% confidence Interval of the difference				
	Mean	Std D	Std Err	Lower	Upper	1	df	Sig(2-tailed)
Paired A-B	11.063	17.582	4.396	1.694	20.431	2.517	15	.024

These results show that even though the ideas generated by the proposed model have just a short time test, the model can still have significant effects on the design work. Therefore, the evaluation of the work made this research more complete.

5.4. Conclusions, limitations and future recommendations

Conclusions

In phase I, it was found that during the original design, the designer is easily distracted by the users. Additionally, the assessment from designers showed there was a high level of satisfaction when using the proposed model. When evaluating the idea generation, the statistical results showed that the ideas generated by interacting with users were more attractive to the pre-set target users. This model, therefore, is able to lead non-UCD designers to undertake UCD without needing to be taught further design knowledge as well as designing both aesthetically and functionally.

Research limitations

Several constraints existed in this study. First, the duration of the task arrangement is limited, and may lead to designers not designing as well as they usually do. Additionally, the short period of time made the ideas less concrete. Second, the designers were asked to use one of their current design methods, namely a sketch. Sketching is the most common skill of designers and it is good to use for the comparison in this assessment. However, some of the designers may tend to use additional methods to benefit their idea generation. Hence, this part may contribute towards the bias of this task assessment.

6. A framework design for the application software that is implemented in the UCD model for idea generation

6.1. Introduction

The study targeted those design practitioners who had never used personas, and who had no idea about how to use personas in their practical projects. Although this does not set constraints for the software users, it does set up a software boundary in order to put more effort towards those who are not UCD designers, and to initiate them into UCD design. Consequently, under such conditions, the difficulties of applying personas were investigated and the rationales were built for this research. 20 designers were asked to design a portable device, firstly before using personas and then after using them, and this aimed to identify the problems. The think-aloud protocol method and questionnaires were applied to acquire the data. In this study, most of the designers revealed that they had never heard of personas before. However, after instructions were given, they were all capable of using personas in their design. In addition, they showed a willingness to apply personas in their designs in the future. However, they did not know how to create their own personas, which gave a strong reason to construct the application software.

Second, a software plan and its implementation were undertaken, which involved several considerations to enable the application software to be used more practically.

The application software utilised a combination of Flash, PHP and MySQL for cross-platform access, and which will allow a bigger project to share personas between stakeholders. The upper layer software (Flash) is mainly used for handling the user-interface and visual elements; the middle layer software (PHP) handles the functionality and behaviour design, and is connected to both Flash and MySQL; the lower layer (MySQL) handles the personas. A proper categorisation of MySQL was needed to make new personas. The application software also needed to consider the flexibility so as to extend new attributes for future use. Additionally, the persona tutorials, with step-by-step instructions for creating personas, were considered as one of the main features since most of the designers wanted to have

instructions on how to correctly create and use personas. Several other factors were also considered, such as the scenarios for the personas and the products.

It was necessary to create a database to collect the personas. There were three sections of work in this task. The first was to collect the names; the second was to collect the photos; and the third was to collect the personal attributes relevant to market segment factors. The benefit of the persona database is that it can divide the use of the personas into two separate stages: one applies to the use of personas with products; the other creates the personas. The database can make the job of creation much easier, leaving the difficult research part of the application software to assist designers. Hence, the designers can then focus on the interaction of the users.

6.2. Transfer the model into a design specification

Before this tool was created, the requirements based on the previous work in chapters 3 and 4 were applied since this research has attempted to attract non-UCD designers. The exploration process has been noted in Chapter 4. Therefore, the service scope was defined to include budget-limited companies and individual designers. A proposed UCD model was also introduced.

The survey was based on the following questions

1) What are the current design methods used by smaller companies?
2) Why do those designers fail to follow UCD?
3) Can a model be proposed that will encourage designers to apply UCD and improve their UCD design?

20 product designer practitioners were invited into the survey. 13 of the designers were from Asia, six of them were from Europe and one was from the US. As can be seen from table 1 below, industrial designers were interviewed in the first and second phases. Within the group, there were 13 senior designers with more than five years of work experience. Five of the group were junior designers with between six months and five years experience. The final group member was a senior design student who had only run independent design projects and group projects.

There were two design tasks given to complete the answers to the three questions above. It was understood that user-centred designs were not popular with our target designers. However, even though they had never heard of the UCD

terminology, some of them were able to include users in their design practice. Interestingly, some of them claimed that they used had UCD in their design work. However, their work in the task actually failed to consider the users. The general design pattern for this group was that they did not design with the users in mind.

The failure factors when practicing UCD were found to be that the users were not reachable because of environmental limitations, and even when the users were next to them, the designers had problems interrogating the users' needs. As a result, it was noticed that the design practitioners were very different from the design researchers. If the method was too complex, the designers usually tended to fail when following the method.

Considering that, in most cases, the users were unavailable to the target designers, this study used personas as the basis of the proposed method in order to create a customised UCD model, as shown in Figure 42. This model was then integrated into their current design work in order to reduce the barrier of applying a new model. Therefore, a third task was proposed.

During the process of the third task, the designers were asked to compare the design work with the customised UCD model and their current design methods. The target designers showed a high level of interest in the proposed model, above, and they were happy with their design ideas. However, the creation of personas seemed to be a big problem for them. Therefore, the motivation to develop persona application software was formed as a solution to this problem, as per the concept demonstration in Figure 43.

The requirements of the persona application software were, therefore, collected after the task arrangement, as shown in Table 10.

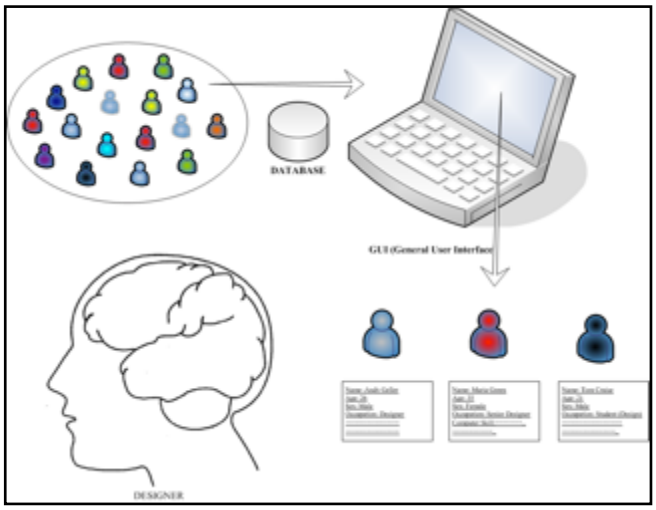

Figure 44 The Concept of the Persona Application Software

Table 10 Software Application Requirements

Application Software Requirements	
Users	Low-budget design companies
Operational System	Web-based, which makes the software application a cross-platform system
Database	Enables persona data to be reusable
Application	Tutorials to guide designers in the better use of personas
Application	Creation of personas
Application	Views of personas that allow designs to interact with the personas
Application	A note function for them to write down their ideas with global views of the different personas

6.3. Application software plan and architecture

After the requirements were collected, the application software architecture for the proposed UCD model was defined.

As can be seen from the illustration in Figure 43, there are three layers to this software; one is the UI (user-interface) layer, one is the middleware layer, and the other is a database layer.

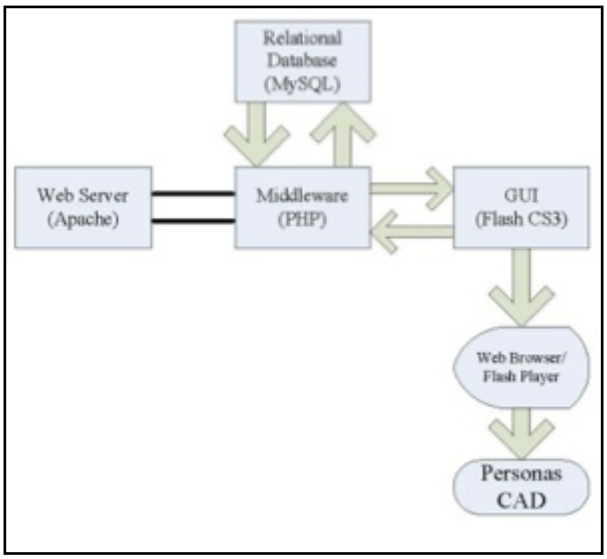

Figure 45 Application software structure for the proposed UCD model

The initial target missions can be set in order to develop the individual concepts. The designers are expected to work and discuss their ideas with all other stakeholders. Hence, the software was created with a web-based structure. In addition, the web-based structure can eliminate the impact from different computer operating systems. In other words, a web-based structure can make this application software more universal.

This software follows the working model built by Chen et al. (2009), which is a mixed-method model for designers' concept development. The mixed-method model has several benefits:

1. It does not change the methods that the designers currently use. It introduces the personas and empathic thinking into the design process with minimal impact.
2. The model is user-centred.
3. The model provides functions with idea management for interaction with the personas.
4. The model divides the job into several sections. By doing this, it ensures that designers can work in their own professional area. The remaining work can be done by researchers from different domains, such as computer science, ethnography and design.

User-interface layer

The user interface is very important and is a key factor in the success of the UCD application software. Most of the scholars agree that the aesthetic factors are also important in terms of creation of the user-interactive function. As a result, the user interface can be regarded as two parts (the functionality and aesthetics of the application software development), and both parts will need to be taken into account when doing the usability test. Figure 44 demonstrates the UI (User-interface) design for the UCD application software.

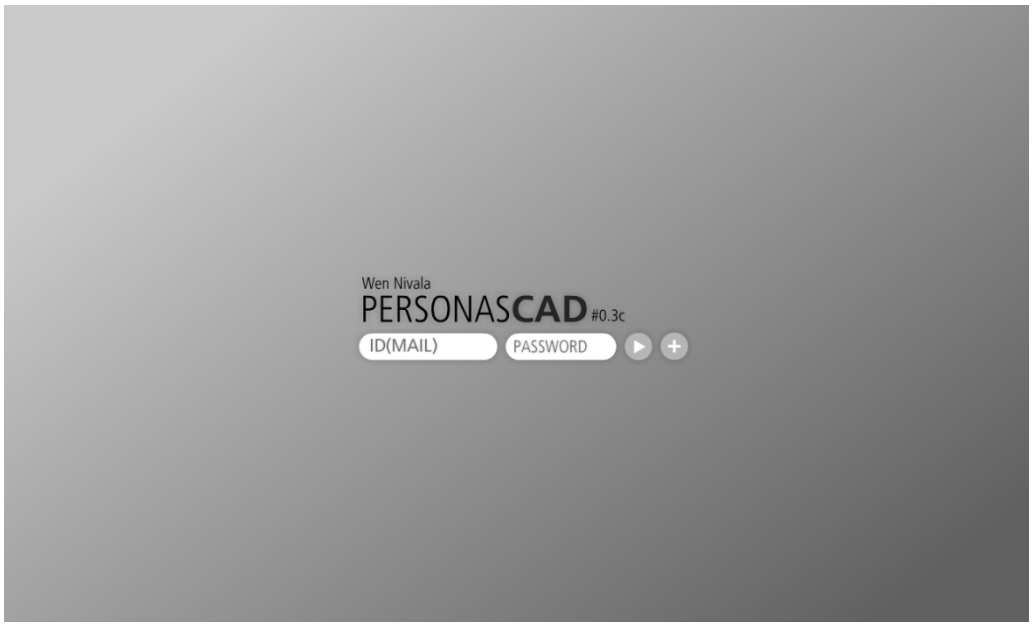

Figure 46 Main page (Login Entry)

Web-function: This includes the classification of user privileges. As can be seen from table 11, three kinds of users are defined: one is the guest, one is the normal user, and the other is the administrator.

The administrator has the highest rights and can control every setting of this application software. The normal users are allowed to set up a project, create personas, and use the concept development and tutorials. The guests are not expected to do anything regarding the project creation; they are only allowed to learn about the personas in the tutorials with regard to this application software. However, although three classes of users have been suggested, this is only as a reference.

Table 11 User privilege layers

User level	Job Coverage
Administrator View	The person who has the power to manage the database, projects and administration work
Normal user View	General users who can manage their project and create their personas.
Guest View	Able to learn the persona tutorials using this software

Project creation:

Once the product and the market segment are defined, the creation of the personas is suggested, together with a project name, usually the product name.

After a project is built (i.e. the product is defined), the next task is to create the scenarios and personas for the product. As a result, inside this project, it is possible to further build the environment in which the designers can create their concepts for the product, as shown in the following figure (Figure 45).

Figure 47 Project View

Scenario settings:

As mentioned above, there are several settings that enable designers to configure the parameters for this product. There are two settings; one is the place of use, the other defines the number of users for each product. For example, a remote control is a product for use in the living room and it is a multi-user product; the product is a chair in a hotel lounge for guests and it is a multi-user product; the product is a mug

for children and it is for individual use.

Creation of the persona:

After the setting of the scenarios is made, the persona creation asks to be configured. Each persona is created individually. For every persona made, there are parameters that can be adjusted. However, if the user is new to this software, they can either choose the tutorials to learn how to give the personas different attributes or they can just apply the basic personas to the attributes chosen according to Pruitt and Aldan's book 'The Persona Lifecycle' (2006). Figure 46 is the screen view of the persona page.

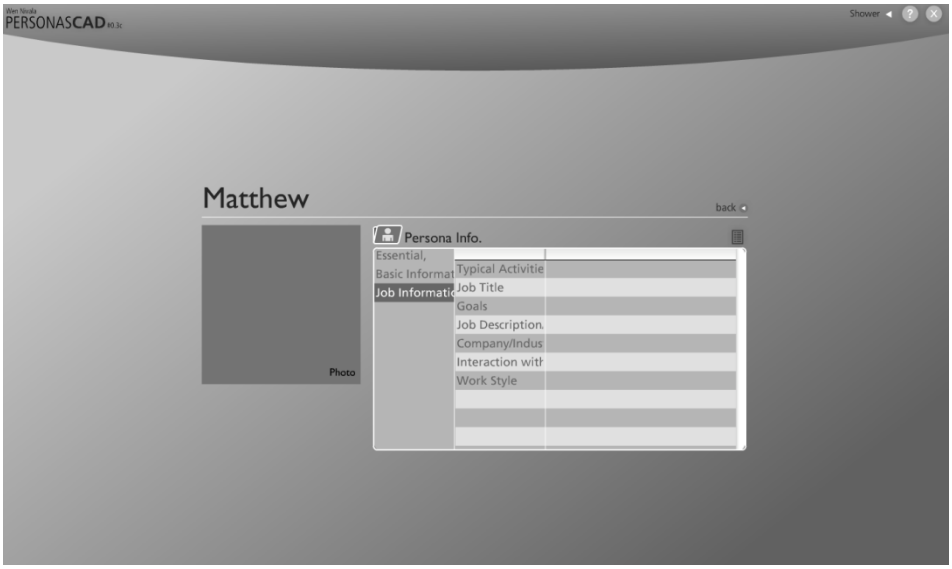

Figure 48 Screen view for the persona page

Designers can create multiple personas to interact with. However, based on the experiences in the literatures, too many personas can be distracting and may reduce the effect of the personas. A general suggestion is three to five personas.

Design Concept Development View: Note Function

After a persona task is successfully executed in the software, the next stage is to generate a design idea and, therefore, a screen view is necessary for designers to interact with the personas. There should be a space for designers to note any ideas generated when interacting with the personas. Therefore, it is suggested to have two views here, one is the view under the persona page, the other is the view where ideas can be reviewed using the cross-persona function, as can be seen from Figure 47.

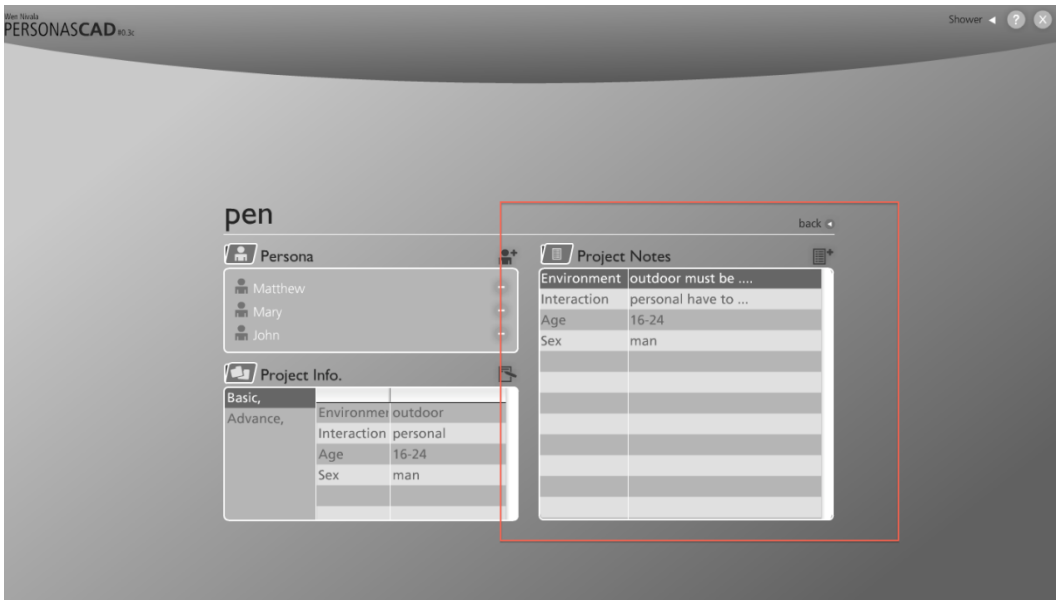

Figure 49 Note Function

Function linking layer

This layer is mainly for the link between the user-interface and the database and is often written in PHP. PHP is a server-side-script and open-source language. It was designed for web development in order to produce a dynamic website. There are many tasks done at this level, such as the rules for creating a persona, and all the flexibilities of the user-interface are made possible from this layer.

Database layer

The database, basically, stores two categories of data: the system data and the persona data. However, the system data explanation will be ignored here since it is similar to all other software of this kind. The database uses MySQL to develop this research. MySQL is open software and has good links to other web software via PHP. Other database software is also workable but MySQL was used for this research because of the fact it is freeware.

The persona database is where the personas are organised. All the literature pointed out the importance of true profiles when generating a persona and this research also followed this rule. It is possible to classify the meta-data of the personas into two types: reusable and non-reusable. Reusable data means data which can be made by programme generation instead of being part of a real user, such as names and photos. The non-reusable data means data that needs to be

the same when the profile is collected. Further analysis of the non-usable parts are suggested but it remains non-separable until there is evidence to support them being reused. Table 12 gives more examples of the data classification.

Table 12 Persona application software data classification

Personas profiles	
Photos	Reusable
Name	Reusable
Age	Non-reusable
Geographic data	Non-reusable
Demographic data	Non-reusable
Scenarios of use	Reusable

Therefore, the database can be seen to be built of three main bodies: the photo database, the name database and the profile database. These databases complete individual persona characteristics that can be used in idea generation.

The selection of the photos

A photo database is used to reassemble the personas. For this research, the photos were licensed from the FERET dataset together with an entry call 'photo uploader' that allows experienced users to upload new photos. The photo uploader consists of many attributes and allows the programme to match the profile database. The basic coding for a file is shown in the following table (Table 13).

Table 13 The rules of the photo database

Persona Photo Rules
File name (Gender)(Age)(Race)(Nationality)(Number) ex: M29XY05 ==> picture is of a male aged 29. Picture is number 5 in the all age 29 group. X is Race. Y is Nationality
Picture size is 640x480 (A bigger picture will be scaled down to this size.)
Picture file category is .gif

Although the photo can be further classified with more metadata combinations, in this research, only two factors are assumed: age and gender. The factors of race

and nationality are neglected in order to simplify the setting. However, the software still provides clear ideas and a plan for programmers for extended use.

The selection of the name

The name selection has the same consideration as the photos. The name selection somehow depends on the culture. In this example, some parameters are given and a reserved space for further extension. The parameters and their explanation are shown in Tables 14 and 15.

Table 14 The rules of the name database

Persona Name Rules
Parameters: Geographic
Parameters: Nationality
Parameters: Age
Parameters: Reserved

Table 15 Persona profiles

Persona Profiles
Geographic profile
World region/Country
Country region
City size
Urbanity
Climate
Demographic profile
Age
Gender
Family size
Income
Housing type
Occupation
Education
Religion
Race/Ethnicity
Nationality
Psychographics
Social class
Social group status
Social network role
Personality and Self image
Beliefs

Attitudes
Acceptance of innovation
Lifestyle motivations
Lifestyle traits
Interests/hobbies
Media read, watched, or listened to

The selection of the profiles

As suggested in the literature review, the field investigation from real users is not neglectable. A real character has plenty of parameters. However, additional factors make the data collection more difficult and complicated. Therefore, this research adapted the factors which matter to the product and optimised them into a reasonable number of parameters in order to efficiently acquire enough profiles from real users.

Additionally, this research aimed to provide an idea of how a persona software application was built and shows flexibility for extension when more factors are required. Consequently, the factors that were not used in this software can also be considered whenever the research requires.

On page 235 of 'The Persona Life Cycle' (Pruitt and Adlin, 2006), there is a guide to selecting the parameters that shows us the frequency of the persona characteristics.

Therefore, this research selected frequency parameters of over 60% usage. The following list was built as per the profile in Table 15.

An entry to collect profiles from real users was also considered as this would allow the designers or ethnographic experts to import user data more efficiently, thereby reducing the difficulty of using personas for design practitioners.

Tutorial function

Every software product needs to have a tutorial to guide the users and tell them where to go when they get lost under certain conditions. The persona application software contains tutorials and a help function. By creating the tutorials, users can understand some common ground. For example, they can understand how to create a persona, how to interact with the persona and how to generate their ideas

using their current methods and personas.

In addition, the designers can learn how to modify the personas and how to import the persona database when they have more understanding of the persona application software.

The help function, however, is displayed throughout the software. It aims to provide instructions for users to avoid them feeling confused and this enables the software to attain better usability.

6.4. Conclusions, limitations and future recommendations

Conclusions

To create persona application software it is necessary to have a comprehensive knowledge of personas and their limitations and this made this paper invaluable.

This paper has demonstrated the whole detailed process regarding persona application software. First, the motivation was revealed for this persona application software together with the requirements needed. Second, a clear structure for this tool was planned. Third, a detailed design was given to show a clear picture of this application software.

The persona application software followed the mixed-method UCD model, built for use with the model since the design problems were realised, and the intention was to solve those problems. Therefore, the main spirit of this software is to bring personas into the practical world because, as this investigation showed, design practitioners, potentially, want to use personas but they need simple instructions.

Therefore, the creation of personas can be left to the researchers, and all they need to do is to use it while designing. This concept has a clear division between the research and the practical work, and only the practical work is needed for the designers.

To consider the reusable and non-usable factors makes the persona application software more cost-effective. Nevertheless, this section needs to be performed carefully since the evidence shows that only a true likeness of a persona is the

acceptable result for design work. The incorrect way of creating personas may lead designers into a worse situation when designing.

Future recommendations

There is still some work left to do behind this research. The first task is the usability test for the persona application software. By doing a usability test, any hidden problems raised by users will be found. The second task is to collect user profiles from real people in order to enrich the database, and to collect more photos for different market segment uses.

The suggestions for this research are as follows:

1. **To make the advanced personas flexible enough to enable designers to manually change certain attributes of the personas when they reuse them**.

   The reuse of personas will possibly appear. However, the research from the literature told us that using the same personas for different scenarios would lead to stereotyping.

2. **To undertake further research on the selection of photos.**

   In this research, one interesting area that was noted is how to influence the different ways of displaying photos across all aspects of a design. In particular, the area regarding different face presentations seems to make designers curious.

3. **To implement the whole** application software **with a finished database.**

-

   A structured guide for programmers to build a complete project was provided in this chapter. No matter which software language is used, the generic structure can be regarded as a trunk for it. However, a complete software implementation would be useful as a complete evaluation of the user experience. This will help to provide more suggestions for a better software application and encourage more UCD usage.

7. An assessment of the software application framework used to implement the UCD model in idea generation

7.1. Introduction

UCD practice is complex and costly and, therefore, these obstacles reduce the usage rate of UCD. In the previous chapter, a UCD model for idea generation was created which encouraged designers to design using UCD. Nevertheless, even with the UCD model, which designers were highly satisfied with, problems were still found which stopped UCD being used further. One of the most difficult problems to overcome is that of persona generation. In the process of evaluating the UCD model, it was discovered that designers can integrate personas naturally into their design but there is still the gap of providing the personas.

Therefore, a cross-platform application software was suggested that reinforces the use of the UCD model as well as enabling the creation of the personas. Application software has been used to assist design work for a long time and, as a consequence, an industry called 'service design' has been developed in order to facilitate the designers' environment. The detailed design is illustrated in the previous chapter.

In this chapter, a further evaluation of the persona application software was carried out to acquire feedback from the design practitioners. The purpose of the evaluation was to ensure the design specifications of the application software were built properly in order to eliminate any UCD difficulties so that design practitioners are happy to use it.

13 design practitioners were invited to evaluate this application software structure and specification. Card sorting was employed to interact with the participants, followed by questionnaires and interviews. Additionally, N-vivo was used to transcribe the information.

The participants revealed difficulties in creating usable personas and the long process of creating one did not seem to be a viable option for them. When they were asked to sort the cards, they concluded the functions they needed were the ability to create trustworthy personas easily, and the tutorials. Subsequently, when

the participants interacted with the application software, they were able to understand the operation of the persona tool via this application software.

This persona application software, therefore, proved that it can help the persona-based theoretical UCD model to be more usable and, as a consequence, this will help to encourage more usage of UCD for idea generation.

7.2. Methodology

Aims

The aim of this study was to evaluate whether the persona application software was useful and that the specifications were made correctly. These were then implemented so that the theoretical UCD model could be executed. This would benefit designers in idea generation and promote UCD to non-UCD designers and those designers who have difficulties in practicing UCD.

Objectives

The objectives in this chapter are:

1. To investigate the participants' understanding of personas and UCD in order to collect the profiles of designers in relation to their interests and requirements.
•
2. To investigate the designers' needs and the results as per the guidelines to the application software for UCD idea generation

Methods

In this chapter, semi-structured interviews were used initially to interact with participants in order to find out their understanding of persona usage and creation, as well as UCD. In the second stage, card-sorting skills, which are popularly used in usability tests, explored the needs of the participants during the product front-end process, and were also conducted to interact with the participants. Meanwhile, think-aloud protocol (TAP) was also used when the participants were undertaking the card-sorting. Following this, a preliminary application software design was distributed so as to receive a qualitative review from the participants. During the last stage, the results were organised and transcribed by NVivo. The methodology

of this assessment is shown in the figure below (Figure 48).

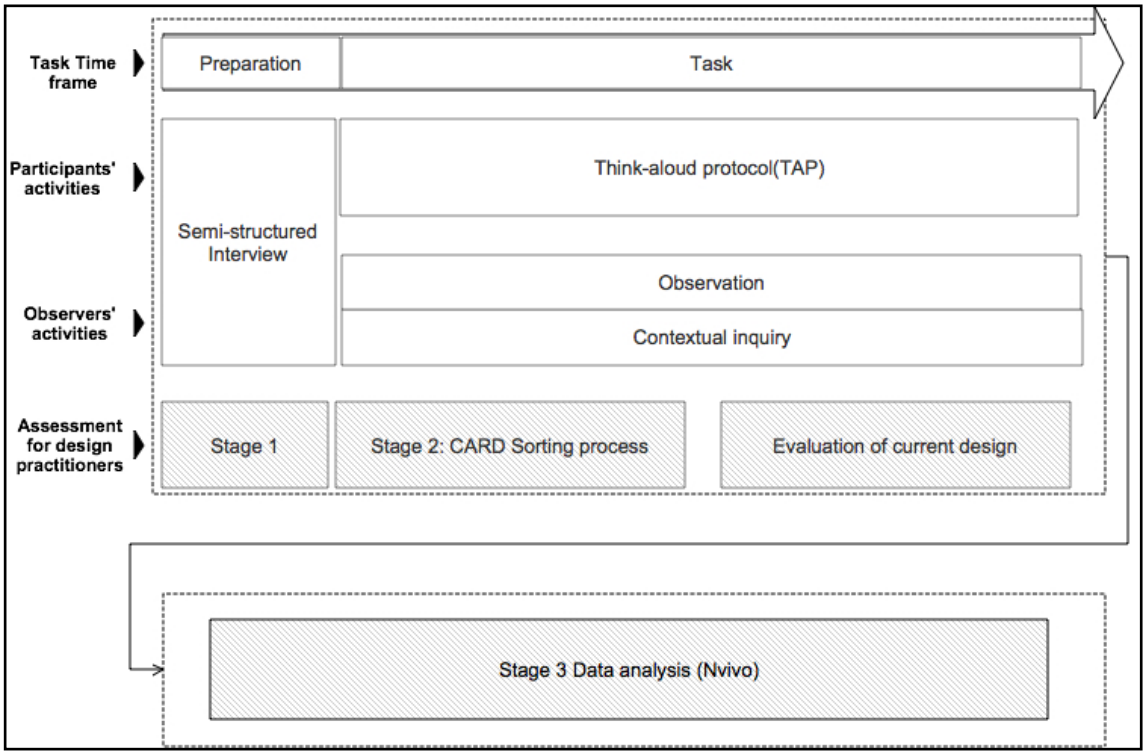

Figure 50 Assessment Flow Design

Participant selection and the task design

Participants working as design practitioners were invited to take part in this assessment. The tasks had four main topics with other blank cards in order to explore the needs that were not defined in the cards. Therefore, the five groups of cards were defined as follows:

1. General functions of the application software
2. Persona creation
3. The use of the UCD model
4. The tutorial function
5. Others

As discussed in Chapter 3, there are two ways to initiate exploration in the card-sorting: open cards and closed cards. Open cards aim to build the users' mental model at the very beginning of the product design while closed cards help fine tuning or with tasks already within the initial design. In this case, the task was similar to closed card-sorting. However, one open group was left for whenever participants had thoughts which could not be accomplished by the cards that were

already defined. The definition of the tasks (closed cards) is listed in table 16. The card sets for this assessment are shown in Figure 49.

Table 16 Definition of Cards

	Group	Detail cards
1	General functions	Registration, log in/log out. Creating a project, project setting,
2	Persona creation	Edit photos, edit names, edit profiles, import new database, advance personas
3	The use of the UCD model	Introduce persona 1, introduce persona 2, introduce persona 3, introduce persona 4, introduce persona 5, creating ideas, creating a project, idea management,
4	The tutorial functions	What is a 'persona'? Examples of personas, example of creating a project, general function, help, 'search' for help, creating personas.
5	Others	Blank cards, hierarchical prompted cards (layer one, layer two, layer three, etc.)

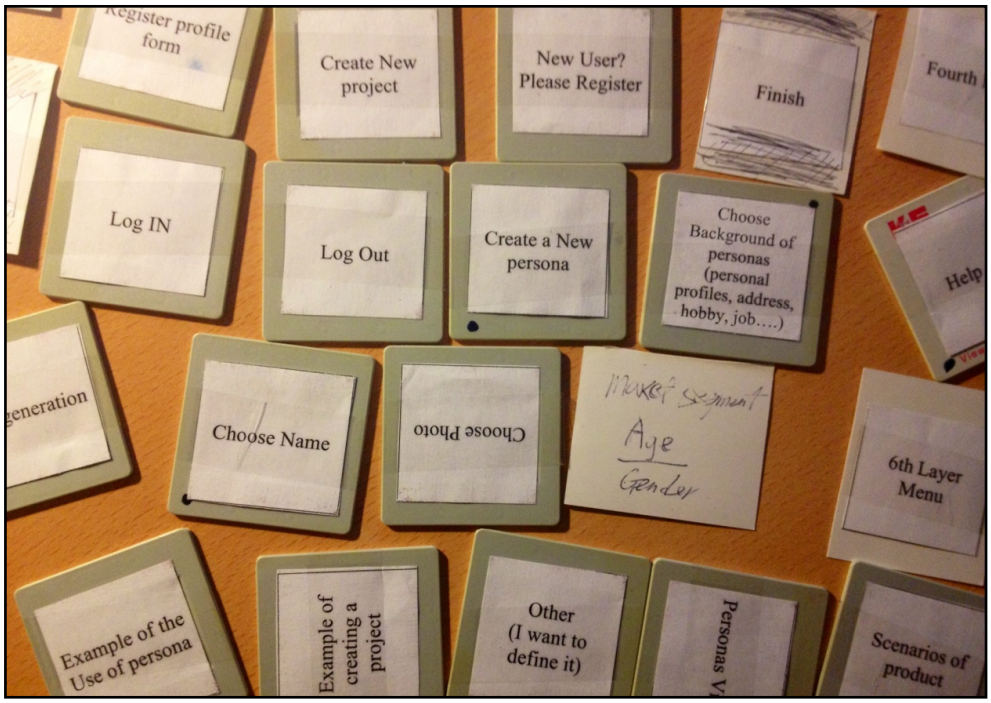

Figure 51 Cards with definitions (Closed Cards)

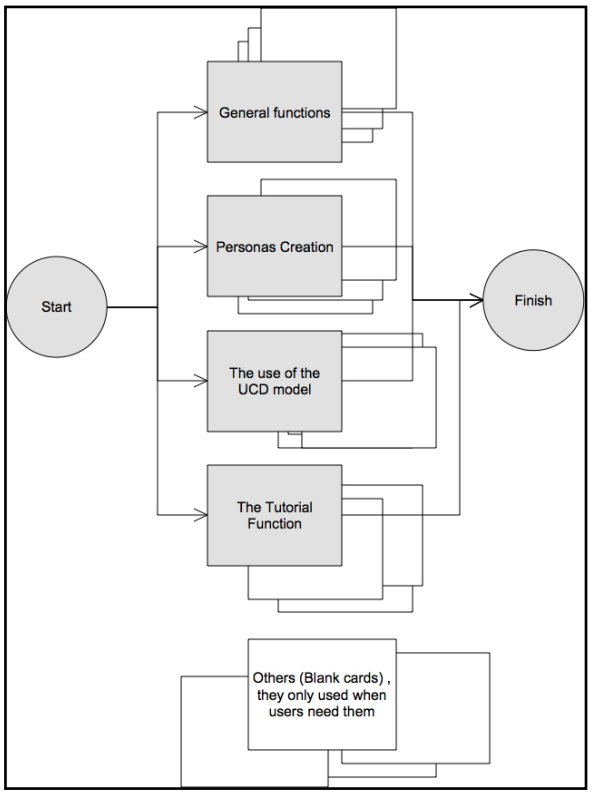

Figure 52 Four groups of tasks and one blank card in the card-sorting assessment

The assessment took place in the professional usability laboratory. The set up of the environment is demonstrated in the following figure 51. The advantage of using the usability lab was to help participants concentrate during the whole assessment process since it has a soundproof design and the layout can be modified according to the needs of the research. In addition, the video and audio recording devices allowed recording from multiple angles, as can be seen from Figures 52 to 54, which allowed observation of the participants more clearly when they were undergoing the assessment.

Firstly, the participant was invited into the lab following the completion of a questionnaire to ascertain their related background. Following this, they were invited to the sofa for a further semi-structured interview regarding personas and user-centred design. Meanwhile, they were also given a general introduction to the task in order to familiarise them with the scenarios. In the second phase, the participant was asked to use card-sorting skills in order to explore their needs in the persona application software design. Before the card-sorting process, the rationales for the creation and operation of the application software were explained

together with the theoretical UCD model for idea generation. Participants were then asked to show ‘the specification for the persona application software’ by using card-sorting skills. In the last phase, a preliminary design for the persona application software was shown for evaluation as well as a closing questionnaire.

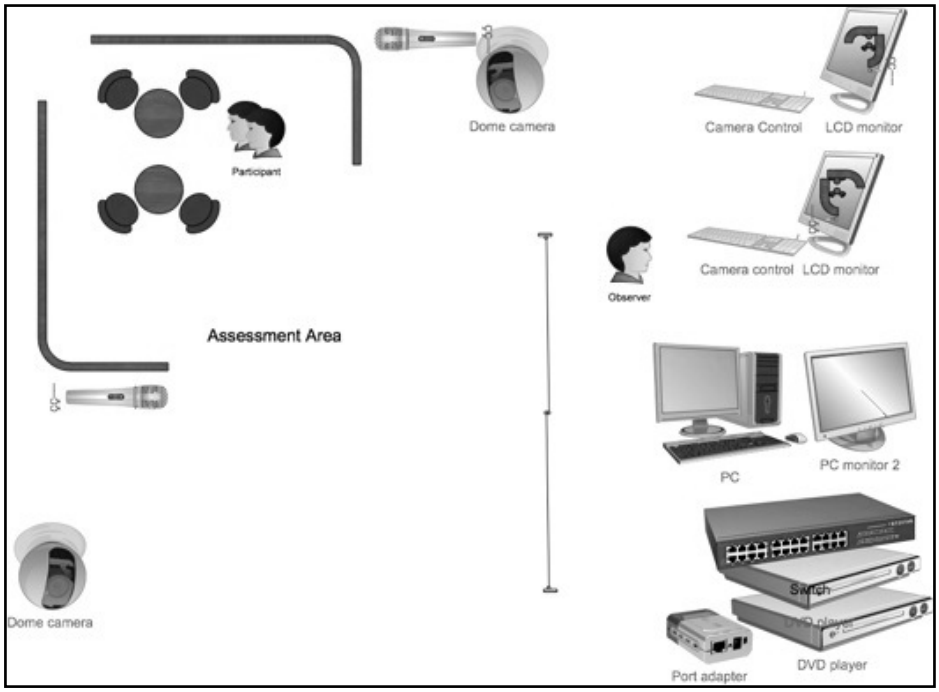

Figure 53 Usability test layout

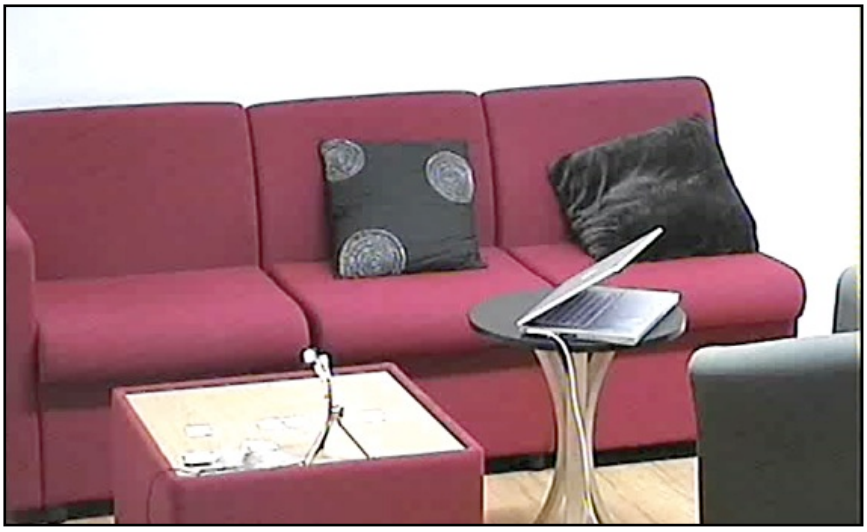

Figure 54 Setting for the interviews (Front View Camera)

Figure 55 Side view of the camera

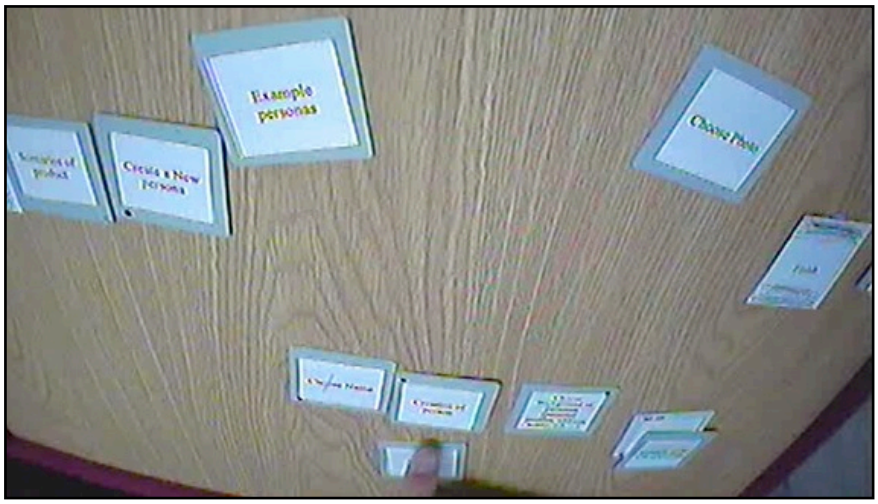

Figure 56 Settings for the card sorting (Mini camera view)

7.3. Results and discussions

The investigation into the understanding of personas and UCD

In the first process, it was important to know the background of the participants and to gain an understanding of their knowledge of user-centred design and the personas as this was the main interest in this research. The interview started with a discussion on user-centred design as none of the designers had any practical experience of using it. All of them, however, had heard of UCD and had different degrees of understanding, as shown in Table 17.

Regarding the personas, only one of them could roughly describe a persona but did not have the knowledge of how to use it. Five out of thirteen participants had heard

of the terminology without understanding the details and seven of them had never heard of personas.

Additionally, the experience of operating application software in their own projects was explored in order to carry out the later task. Three out of thirteen participants were experienced application software users and many (six) participants had used application software a few times in their previous projects. Four of them had also learnt how to use application software but they did not use application software in their designs. Overall, they all had experience of using application software as a tool during design but not everyone had used it as a design tool.

Table 17 Designer Background

No	Design background	Experience of design	Degree of Understanding of personas or UCD (1-5)[*1]	Application software use experience (1-5)[*2]
1	Product design	More than 5 years	3	4
2	Product design	More than 5 years	2	2
3	Product design (multimedia design)	3 to 5 years	1	3
4	Product design (Fashion category)	Graduate Student	1	2
5	Product design	3 to 5 years	2	3
6	Product design	1-2 years	2	3
7	Product design (multimedia category)	1-2 years	2	3
8	Product design (multimedia category)	1-2 years	1	4
9	Product design	3 to 5 years	1	4
10	Product design	Graduate Student	2	3
11	Product design	Graduate Student	1	2
12	Product design	1-2 years	1	2
13	Product design (multimedia category)	1-2 years	2	3

*1.Degree of understanding of personas or UCD:
1. I have heard of UCD and personas
2. I know UCD
3. I know of UCD and have heard of personas
4. I know of UCD and personas
5. I have used UCD in my design or I have used personas in my design

*2.CAD usage experience
1: I do not use CAD in my design work
2: I learnt CAD but I do not use it in my design work
3. I have only used CAD a few times
4. I use CAD a lot in my design
5. I always use CAD to do my design

Card-sorting process

During the short explanations of the ‘introduction to the theoretical UCD model in idea generation’ and the ‘introduction to personas’, participants showed a high level of interest in using the persona application software in their design work and were highly motivated to help with the card-sorting task.

- **General functions in the persona** application software

In the first task, the participants were told it was going to be a web-based application software, and they were asked to take part. All of them could do this in the same manner, as Figure 55 shows. This means they all had a good concept of entering a website and accessing software of this kind. Some of the participants showed a high level of interest to see the persona/idea generation software work as this is a web-based concept.

Figure 57 Administration function /General function group

- **The use of the UCD model**

Second, the participants were asked to initiate a project, named by the product name, and the task was explained to them as: ‘the project suggests using the product name, and you can give scenarios as well as users (personas), please try to assemble the cards’. In order to help them to sort out their thinking, cards were used to note the different layers for them.

Although all the participants had experience of operating application software, the understanding of the software was still the key to finishing this part of the function. Therefore, as all of them were new to this tool, they had pretty similar ideas in the

card-sorting process, except for the functions which could give them help. These functions, namely ‘tutorial’, help’ and ‘example of a project’ were selected in several ways, as Figures 56-58 show. However, it was evident that, for new software, a clear guide to enable users to learn is very important.

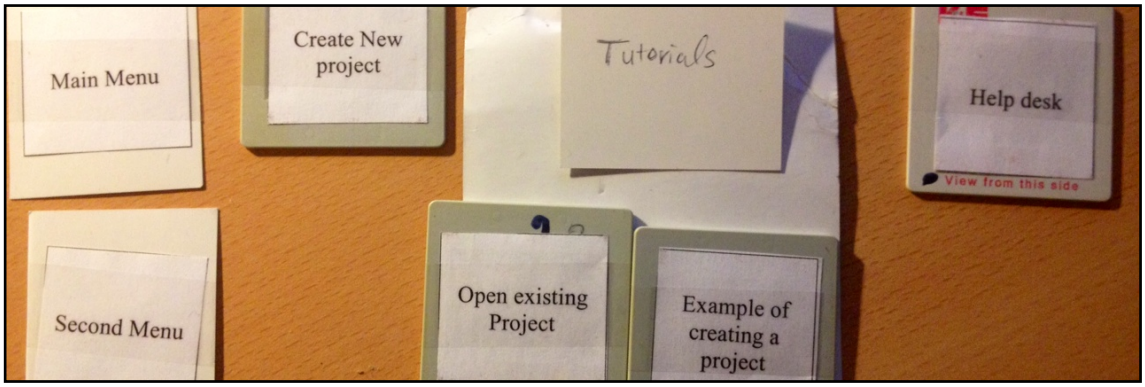

Figure 58: Result 1

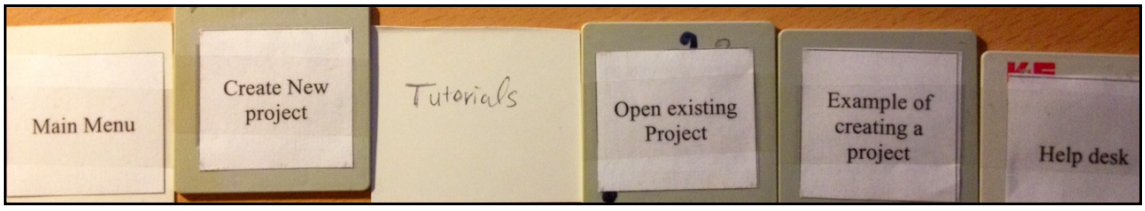

Figure 59: Result 2

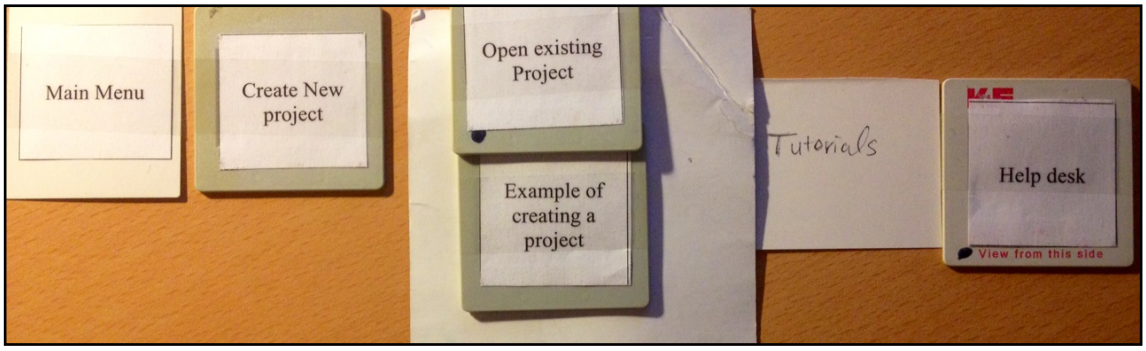

Figure 60: Result 3

Next, the proposed UCD model was explained to participants at the beginning of the assessment. They were asked to offer their suggestions and to assemble a function which could assist them in idea generation, just as the UCD model shown to them. Additionally, it was specified that they would not need to use the persona database in this task.

During the process, the participants showed great interest in these ‘mind models’ and this resulted in two different card combinations, as shown in Figures 60 and

61. In Figure 60, the participants preferred to have the idea generation windows crossed with many layers in order to stimulate their ideas all the time. In Figure 61, the participants developed this scenario in order to minimise the layers but with the same purpose; they wished to generate an idea under the environment which could provide them with the most information. In this development task, participants were happy with the UCD model since they showed apprehension towards a complicated research model. They all expressed the opinion that the application software might give them lots of help to conduct the UCD model.

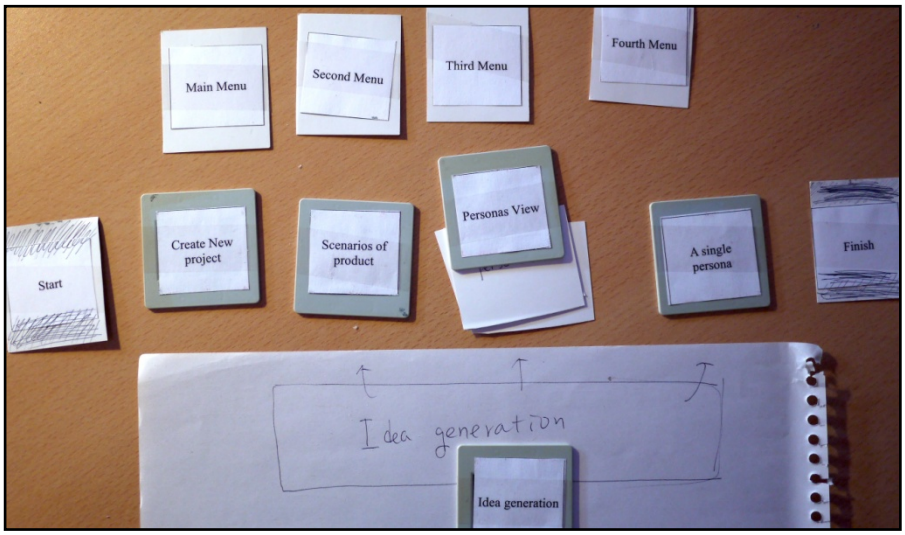

Figure 61 Card-sorting process- result 1

Figure 62 Card-sorting process- result 2

Persona Creation

Since participants were very new to the idea of personas, they were especially interested to help with the completion of this feature as none of them knew how to generate the personas shown earlier (Table 17). During the process, the researcher had to interact with them all the time. The questions were ‘What information can I change?’ and ‘Which information is true?’ These questions implied that they were concerned with the reliability of the personas. None of them showed any intention to view the books and documents provided regarding the creation of personas. Based on the reliability of the personas, participants wished to have a very easy way to create them. In addition, participants expressed that they were unconfident if their job involved taking care of the details of persona creation. The process, therefore, was finished once the explanations and instructions were given. The structure of creating a persona was basically agreed as Figure 62.

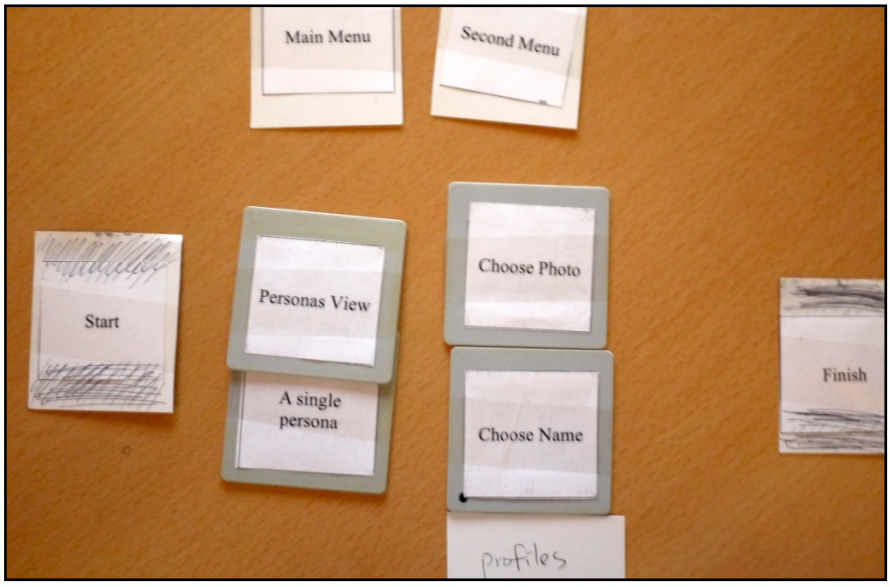

Figure 63 Creating a persona

- **The tutorial functions**

As in the previous task, when the participants were asked to assemble the cards, they showed great interest in the ’tutorial’ and the ‘help’ function. In this section, they were requested to design this part of the function to help them improve their use of the application software. When designing the tutorial functions, participants, who were mostly non-UCD designers, showed a high level of interest to make this function well. This was because they would like to become UCD designers by using this application software in the future. The construction in this feature is shown in

Figure 63.

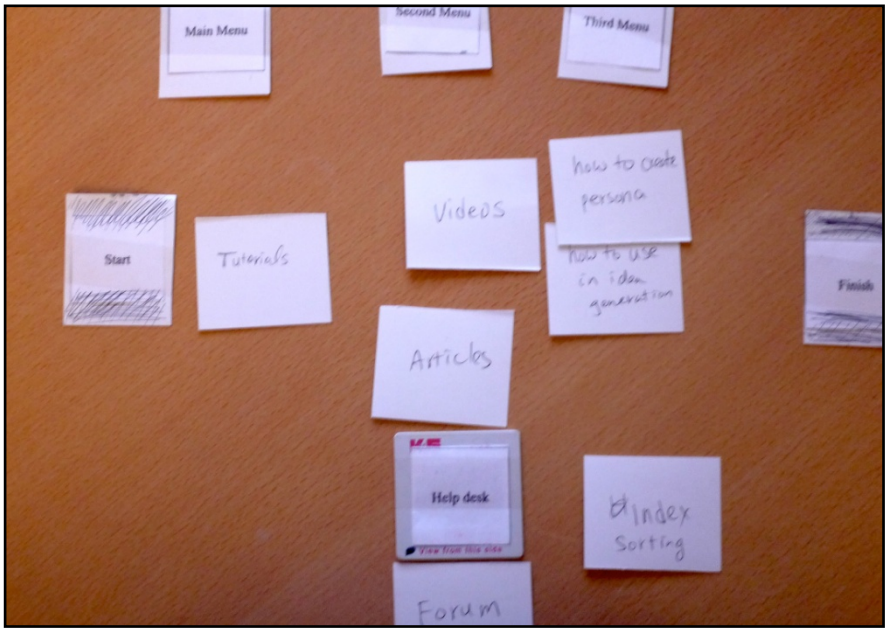

Figure 64 Tutorial function

- **Other**

In this session, the participants were asked if there were any additional functions they wished to have. Some participants had the idea of having the functions integrated with a social networking function in order to share ideas with their peers. Additionally, some of them mentioned about the photos of the personas as they wished to have the choice of as many photos as possible for each persona. In the process, participants showed more interest between the photos and idea generation and, as a consequence, the reliability was built up from the user profiles based on their feelings.

- **Evaluation of the current design**

In the last session, they were shown the current design work. Because they already had some concept of this model, they basically felt that the application software provided more depth than they needed since it included more details for persona creation. However, the participants felt satisfied that the application software had taken care of the function of creating personas.

Each of the tasks given to the participants earlier were reviewed (general function, the use of personas, persona creation). The participants did not show any negative

opinions about the context, even though part of the context design was different from the model they had created in the earlier card-sorting task. This may suggest that the application software had a successful structure and that the differences in the application software could be easily learnt by the participants.

The card-sorting process successfully acquired validation for the UCD idea generation application software. However, because the participants had little knowledge of UCD or personas, it was difficult to ask them to do the open card-sorting process. Consequently, the majority of the assessments were built on closed card-sorting. This suggested that if a new product was outside the users' knowledge, closed card-sorting may be used predominantly rather than open cards. However, open cards are always useful for injecting new ideas.

Participants showed satisfaction (5 highly satisfied, 8 satisfied) with this application software and they felt happy that there is a tool that can help them to focus better on their users.

7.4. Conclusions, limitations and future recommendations

Conclusions

This study shows that the evaluation of the UCD idea generation application software is useful and that the specifications were made correctly. The card-sorting was useful and the closed card-sorting is more likely to be used when the participants are not familiar with the concept. In addition, a tutorial function has great importance according to the participants' feedback.

Research limitations

This research had limitations as the participants' knowledge of the personas and UCD restricted a detailed construction of the application software. Therefore, the assessment had to be moderated most of the time.

Future recommendations

1 Even though card-sorting was very useful in the initial stages of the application software design, a real design can earn more input from participants in the later stages. Therefore, a revision of the application

software is suggested in order to design and evaluate and to acquire more feedback.

2 The tutorial function has to be more complete since this application software has to attract users who are not UCD users.

3 Visual stimulation had a great influence on the participants and, therefore, a future study may be focused on the presentation of personas.

8. General Discussions

8.1. Introduction

UCD has been considered as a good direction to solve the design problems in earlier stages and now. It addresses the view that design should follow the users' needs so as to achieve user satisfaction. This concept provides design answers and suggests solutions, even as technology and products evolve over time. The latest explanation of UCD is the user experience from ISO 9241:210.

Since UCD has been developed for decades now and many research works have applied it in design, it is straightforward to assume its importance in the design process. In the real world, however, bad designs still upset users from time to time. Therefore, a hypothesis was made here: UCD is not as popular as it should be. Consequently, the aim of this research was to try to investigate this phenomenon and then give a solution.

A UCD model for idea generation, which encourages design practitioners to mix and use it with their current design practice, has been proposed in order to eliminate the difficulties of UCD usage. The origins of the model are based on the difficulties found in Chapter 4. An investigation into the creation of a UCD model and its use in Chapter 5 provided the robustness of the UCD model. Meanwhile, a discussion between creativity and UCD will be made in this chapter.

The relationship between this research, empathic design and personas are discussed in a later section in order to explain the structure of this UCD model, while the differentiation between this research and the related works on personas has been pointed out. In the last chapter, the persona application software was discussed.

This current chapter aims to provide an overall view of the discussions across the chapters in this thesis. Figure 64 gives an overview of this chapter.

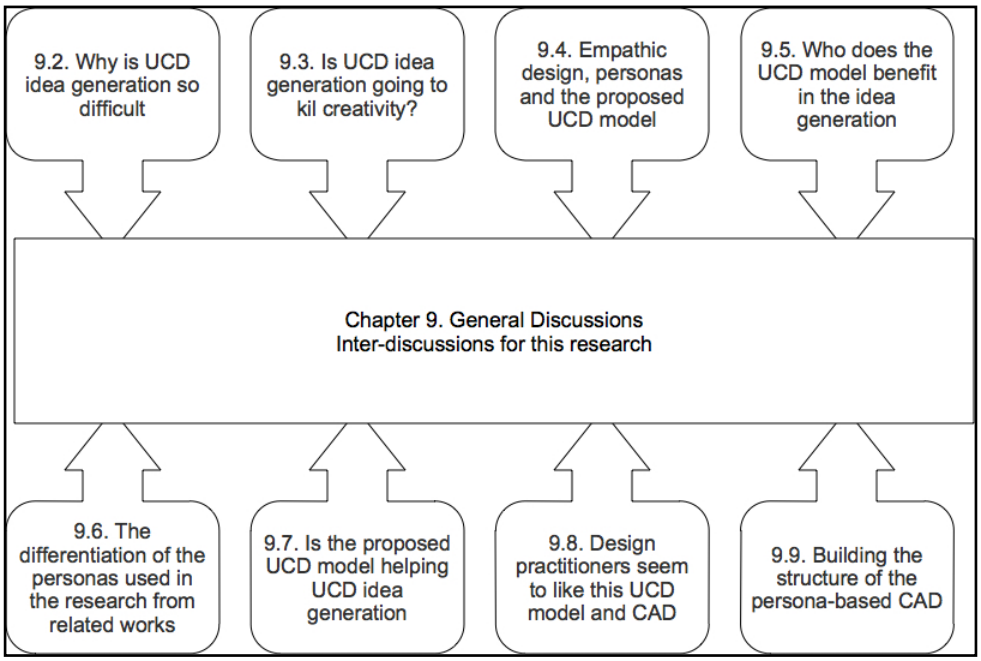

Figure 65 Introduction to Chapter 9

8.2. Why is UCD idea generation so difficult?

The previous work has shown that UCD is mostly used by big enterprises, and that UCD methods are usually complex, costly and time consuming. Therefore, another hypothesis here is that design practitioners with fewer resources have problems with UCD.

As design is originated from the generation of ideas after the market segment has been defined, idea generation is dominant if the design is user-centred. In addition, designers play the most important part of the process at the front-end, especially in idea generation. Therefore, it is a priority to understand the current status in idea generation in this research when exploring the UCD problem. In this research, the term ‘design practitioners’ was used to differentiate between designers and the design scholars.

The aim of chapter 3 was to explore the problems when practicing UCD idea generation and to understand why idea generation is not user-centred from the design practitioners’ perspective. The assumption is that UCD is mostly popular with bigger companies and is less popular in individual design studios and small companies.

The results indicated that the participants (20 designers) mostly did not recognise the term ‘UCD’ until the observer gave a clear definition together with some examples. However, most of them recognised the term ‘user experience (UX)’, even though they could not clearly give a definition and that some of them also misunderstood it. During the whole task, the differences between the researcher and the design practitioners were very clear to see. The design practitioners can use the case to explain their work but the answers are mostly not so straightforward. Therefore, the research tool, NVivo, was used to transcribe the content into systematic and useful codes.

Although the design practitioners were not so aware of the term UCD, there were still nearly half of them who agreed that UCD is important in design work. Interestingly, half of the designers thought it was more commercial to have the strategy of making a design cover as many users as possible rather than putting UCD first. They believed this was more important than focusing on a certain group of users. Regardless of the single participant who answered that users were not important in the design, it is strongly suspicious that the wrong design strategy means that UCD is not widely used.

The participants were then classified in order to identify two big problems: ’participants use UCD as a priority but the design is not user-centred’ and ‘to encourage non-UCD participants to conduct UCD’.

The research shows that most of the participants thought they were UCD designers during idea generation. However, only four out of the twenty participants could barely prove they used user-centred design after the observer asked if they were using user-centred design during their idea generation process. These questions aroused the awareness of the designers and, hence, the questions were designed to help the designers return their attention back to their users. Therefore, it reflects the problem that, in UCD idea generation, designers cannot concentrate on designing for their users by using just the methods they currently use. On the other hand, designers can be distracted, unconsciously, from their users.

The second problem found is that designers think idea generation is the process of creativity, and it can be seen that creativity is given a higher priority than being

user-centred. The sequence for creativity and UCD was not the research concern. Nevertheless, it misleads designers into choosing ideas that are extremely fun or attractive and, therefore, this gives designers a reason to be distracted.

The third problem is that the UCD methods are too difficult for design practitioners. When large companies, such as Microsoft and HP, use anthropologists to understand their users, it means that UCD is too complex. Even though design practitioners mostly have a formal education in design, most of the courses are practice-based and aim to train design skills. This causes the problem that UCD is more popular at the research stage than in design practice. In other words, it can be said that the problem might be because design practitioners are different from design researchers.

One further problem is that most of the designers have a tight schedule for idea generation, and most of the UCD methods are very time consuming.

Regarding the non-UCD designers, it has been mentioned that they prioritise UCD much lower compared with the task of 'designing to catch as many groups of users as they can'. In order to encourage them to implement UCD, an easy method or design flow which will change their current design activities with the least impact should be suggested.

The difficulties in UCD have been identified; the designers are easily distracted; current UCD methods are complex; and designers favour creative work rather than UCD work. Additionally, in order to encourage non-UCD designers to design using UCD, an easier way or flow which can mix their current design activities has been suggested in this research.

8.3. Is UCD idea generation going to kill creativity?

It is worth discussing creativity and UCD as, according to the results, it can be seen that when a proper UCD tool is used, the ideas produced have a tendency to assume the expectation for the same profiles provided. For instance, when asked to design a portable music playback device for female office workers aged 25-34, most of the designers came up with the same concept of the colour 'red' or 'pink'. A question for this research is that it seems the process of UCD can decrease the creativity of the design work.

An explanation for this question is that UCD never constrains the stakeholders during the sequence between creativity and the UCD. If a creative idea is not favoured by the targeted users, the creativity is not helped by UCD. There is no evidence to show that the UCD process will compromise creativity. Consequently, perhaps this tendency can be explained by the fact that designers have a common ground in their impression of 'female', as it is still possible to see different ideas from the participants during the UCD process.

In the process of investigating the difficulties of practicing UCD and the rate of usage of UCD in idea generation, the results showed that UCD is not popular and it is difficult to make participants apply UCD in their design work. Therefore, in the following process, the aim is to solve the problems in order to encourage more usage of UCD and reduce the barriers for practicing UCD at the idea generation stage.

8.4. Empathic design, personas and the proposed UCD model

In chapter 4, a model was proposed which aims to encourage UCD use and eliminate the difficulties of UCD practice. Based on the investigation that designers are not scholars, designers need more specific guidelines to help with their design work. In addition, it is easier to change a younger designer's design behaviour than that of a senior designer. The method or the guidelines do not need to be 'large changes' regarding designers' design methods. A big change in design methods may bring other difficulties to design jobs.

Additionally, the design methods will need to be easier to carry out and they need to be cost effective. Therefore, the empathic design approach is a good way to start.

In the literature review (Chapter 2), there is a discussion about the UCD approaches: participatory design, contextual design and empathic design. There are many guidelines that tell designers how to conduct these approaches but, from the discussions with the participants (design practitioners), these approaches are too 'academic' for them. They are desirable but not achievable in their real work due to the complexity, time constraints and high cost.

This research took the idea of empathic design, with the aim of using the best of

the designers' empathic skills, to approach their target users. Observation is the technique suggested in this approach in order to realise empathy. However, as it can be seen that having users all around the design is costly and time consuming, it is impossible to make empathic design achievable. Therefore, instead of real users, the term 'virtual users' was created for the empathic design and the observations will be the process where designers interact with the 'virtual users'. Figure 65 demonstrates the concept.

If the virtual users are not believable, it is hard to know if the idea generation process is user-centred or not as it is not possible to know whether designers do it incorrectly because the user images are wrong or because the designers just do it incorrectly.

Personas are not an innovative method in the design industry and they are as widely discussed as all other UCD methods. However, the problem is that, from discussions with the design practitioners, the guidelines for creating a persona and the use of personas are too academic for designers. Even though it is known they are complicated to use, personas have the benefit of being low cost since it is not necessary to have real users around during the complete design process. Therefore, in this research, it was decided to take this as the centre of the model and to then improve the use of the personas. The improvements in the use of the personas are in two sections: the first is making personas easy to use, and the second is to make the creation of the personas easier. In addition, the UCD methods will need to be mixed with the designers' current design methods. Consequently, the proposed model was formed.

Subsequently, in Chapter 5, an assessment was arranged to evaluate whether the created UCD model helped the designer practitioners in their user-centred idea generation. In Chapter 6, an assessment was then arranged to evaluate the designers' satisfaction in order to see if they were happy to use this model. The results showed that the designers were more distracted in their current methods when generating their ideas than in the ideas generated by the virtual users.

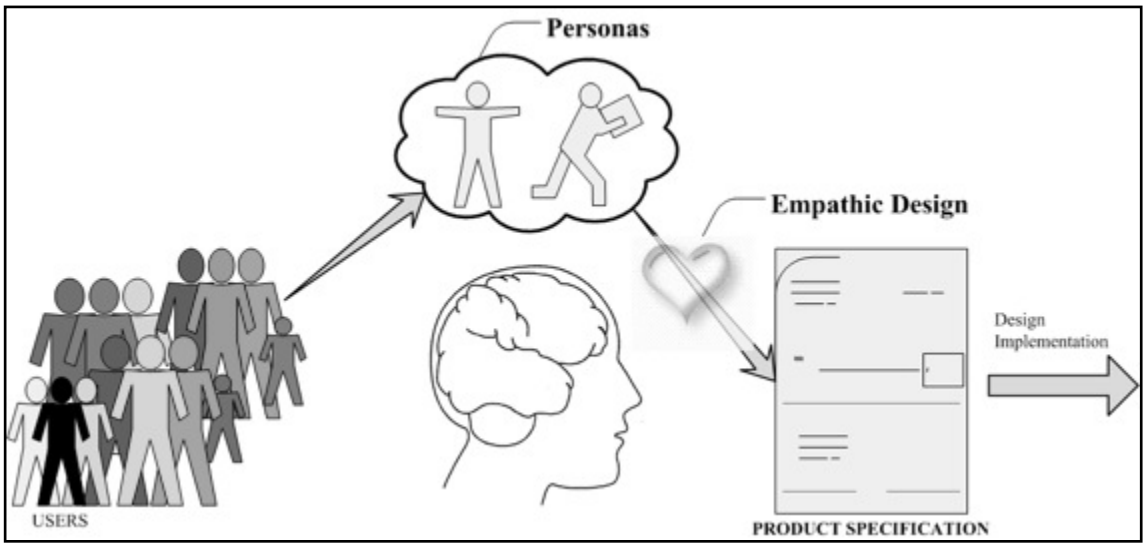

Figure 66 Personas with empathic thinking makes the virtual users workable

8.5. Who does the UCD model benefit during idea generation?

As previously defined, the UCD model is designed for the idea generation stage. Therefore, the UCD model attempts to set up a SOP (standard of process) to assist the designers to design in a more user-centred manner. According to the problems of UCD practice, UCD is criticised because of its high costs in both time and money. The proposed model, therefore, is targeted at the design practitioners who work in small design companies that have small budgets, and designers' individual design work. In chapter 5, it was found that the UCD model is actually useful, not only for the participants with the conditions above, but also for designers without UCD experience or designers who have less experience in design, such as design students.

This UCD model focuses on the stage of idea generation and provides an agile method for the target users. Therefore, whole project stakeholders will also benefit because it makes the process much easier and more cost-effective. It also brings the benefits to the end-users since the products are most likely to be user-centred.

8.6. The differentiation of the personas used in this research from related works

In this research, the main target was to solve the designers' problems when they try to use UCD when generating ideas. As noted in Chapter 4, design practitioners are not design researchers and most of the UCD design methods are too difficult to

just use as a handy tool in their design, including the concept of personas. In chapter 8, one of the missions was to give design practitioners the concept of personas and to attain their willingness to use this in their design work. The answers from the participants' were negative because they did not know how to use them. However, in Chapter 5, it was proven that designers can just have 'virtual users' in their mind with the process prompted by the UCD model. The participants from both researches in Chapters 5 and 8 were happy to apply the personas in their design providing it did not affect the current way they were doing their design work.

This result shows that the current research on personas was useful for providing evidence for the effectiveness of UCD. However, to design practitioners, there is still a gap that stops personas being more popular in use. However, this thesis gave a whole structure for design practitioners to use personas easier. In addition, the model further suggests that creating the personas can be left to design researchers, who can then convert them into the application software to facilitate design practitioners, since creating a trustworthy persona still relies on true user research.

8.7. Is the proposed UCD model helping UCD idea generation?

In Chapter 4, it was noted that the designers have difficulties in practicing UCD work, whether or not they intend to design using UCD. Therefore, in chapter 5, a research was conducted to investigate the designers work. and a UCD model was proposed which is considered to be less costly and less complex. This is because the role of the 'virtual user' was introduced to replace the involvement of real users in the whole process. The concept of 'virtual users' means that the virtual users are created after a certain stage of user research. This is mainly the idea behind personas. However, none of the research has discussed or guided the designers towards an easier way to apply personas and, therefore, from a designer's viewpoint, personas are still a difficult subject. In Chapter 5, a systematic process, which the proposed model referred to, was provided based on the difficulties found in chapter 4. The UCD model aimed to provide guidance in idea generation at each step of the design in order to give the design practitioners simple guidelines to practice UCD idea generation. The process of creating the proposed UCD model

has been stated in Chapter 4. The model employs personas as the basis and encourages design practitioners to incorporate personas into their design just by 'thinking about personas all the time'. However, examining the idea of personas, whilst creating personas, is still a difficulty for designers. In Chapters 7 and 8, application software for a persona-creation method was implemented to solve the problems.

After the model was built, it was important to prove that the ideas generated when following this model were user-centred. Additionally, designers can feel the benefits of using this model. Therefore, in Chapter 5, two assessments were arranged to assess whether designers could use this model easily and whether users would love the ideas that were generated by using the UCD model.
At this stage, the proposed UCD model has been considered as a helpful tool in promoting UCD usage since it has been proven in the assessments by both designer practitioners and end users.

8.8. Design practitioners seem to like this UCD model and the persona application software.

In this research, there was a high level of satisfaction from participants when conducting the UCD model assessment. Almost all of them were impressed that UCD idea generation was so easy. One of the reasons may be because this model encourages design practitioners to design using the tools they prefer to use instead of forcing them to change to new ones. Designers have been given various methods but sometimes it does not mean that they have to design using all the methods they learn.
None of the research suggested or pointed out any specific design tools because it is in a designer's nature that they always like to have different ways to construct their ideas. Therefore, it was decided to incorporate current design methods into the centre of this UCD model to minimalise the changes in the designers' design behaviour.

However, the persona-skills are still very complex and without proper tips, the designers will not be able to design correctly. When the tips are embedded into the persona application software, design practitioners can do the design just as easily as they do in their current work.

8.9. Building the structure of the persona-based application software

It has been discussed previously that the proposed model for UCD idea generation can help design practitioners to apply UCD more easily. However, the model only guides them to 'use' the virtual users. It does not help them to create one. If they want to have a full solution to optimise the use of the model, a concept in service design called CAD (application software) can be the best solution. In order to provide a total solution to encourage the design practitioners in UCD idea generation, this thesis defined the specification of the proposed UCD model. Additionally, a method for creating personas is also included to make the use of personas as seamless as possible.

The reason why the focus was on the structure of the persona application software instead of building such software was because technology migrates quickly these days. The knowledge required to build the application software has more value than building one at this stage. For example, Adobe Flash, widely used in previous years, has now been abandoned by one of the leading companies, Apple Inc. Furthermore, focusing on the rationales of the specifications, in later research it can be implemented easily using the same concept even if the software language is different.

Additionally, the specifications based on the proposed UCD model and the knowledge of personas were not extensive enough in this research. Consequently, in chapter 8, another assessment was undertaken, a usability test for the persona application software, in order to provide a complete guide to the persona application software.

9. Conclusions

This chapter summarises the whole thesis by re-visiting the objectives in relation to the primary studies from chapters 4 to 7 in order to conclude the thesis contribution.
It also assesses the framework of the application software with a product designer in order to test the framework with other product designers, as well as the collection of suggestions for detailed software implementation (See chapter 7).

Objective 1 was concerned with investigating the current UCD design status in idea generation in order to ascertain the difficulties and find out why designers do not use user-centred approaches? The main findings are found in Chapter 3. Difficulties in realising UCD idea generation were identified by product design practitioners. The difficulties are that design practitioners do not regard UCD as a 'must' principle; design practitioners are not design researchers and, therefore, none of them have learnt to use UCD methods; there is a lack of systematic UCD methods available to the design practitioners and, therefore, UCD work can easily become distractive.

In order to offer solutions to increase UCD idea generation for design practitioners, it is necessary to overcome the problems above. The first solution is a UCD model for idea generation, which was objective 2.

Objective 2 was to create a design process evaluation task for product designers in order to construct a UCD model for idea generation. In chapter 4, a systematic UCD model in idea generation has been constructed. This can help designers to integrate their users into their individual design tasks with less effort, thereby developing ideas which are more user-centred.

Objective 3 was to design an evaluation for product designers and the target end users in order to assess the UCD model in idea generation. The main findings were stated in chapter 5. The evaluation results showed that product designer practitioners who followed the UCD model formed in Chapter 4, produced ideas in the product design task which were more favoured by the end-users. In addition,

product designers were satisfied when applying this model. This two-way evaluation provides evidence that a UCD model can help product designers in their product design tasks.

Objective 4 was to design a framework for an application software that could provide assistance in using the proposed UCD model and this was achieved in chapter 6. The result provided the second solution to further facilitate UCD idea generation, by integrating the UCD model into a persona-based application software. Many tips for using personas were built-in seamlessly. Consequently, design practitioners can undertake UCD idea generation without intensive study.

Objective 5 is to assess the framework of the application software with a product designer in order to test the framework with product designers, as well as collect suggestions for detailed software implementation. This was achieved in Chapter 7. The persona application software structure was evaluated by product design practitioners in order to make specifications that can satisfy design practitioners. The results supported the framework guidelines of the persona application software.

The inter-discussion that links all the objectives was made in chapter 8. It not only provided a discussion related to the findings inside the objective scopes. it also extended the discussion to the concerns of the participants.

To conclude, this thesis has analysed the status of UCD for idea generation and proposed practical solutions, including a theoretical UCD model for idea generation and a design framework for its application software. By pursuing these targets, it is hoped that more product design practitioners will have the ability to pay more attention to their users by employing the UCD methods provided. In particular, the UCD model and the assistive application software for idea generation have been evaluated by product designers and the UCD model has been also tested with end-users. The results have shown that design practitioners favour using this model and that users favoured the ideas generated from the UCD model rather than the design practitioners' original ideas. These findings supported the aims of this thesis and the solutions proposed will increase designers' interest and their use of UCD

idea generation.

The main contribution of this research has been to provide a whole problem-solving process in user-centred design, especially the field research with product design practitioners during the idea generation stage; another contribution is the theoretical model in UCD idea generation that can help product designers to recruit users, either physically or non-physically, in a manageable way. The framework guidelines for the application software are the third main contribution.

9.1. Research limitations

Many assessments have been carried out to finish this work and the research limitations for the individual assessments have been listed in each chapter. In this chapter, the overall limitations for future research, to improve and earn more results, are the main topic discussed.

Task design: In each assessment, an attempt was made to assign the same task in order for participants to develop their ideas. However, the background of the participants, such as their area of expertise, may be the reason why the design performance was affected. This is why the task was set as idea generation and management, instead of more specific jobs, in order to avoid additional bias from this factor.
Additionally, the short duration of the task time may also be one of the aspects to affect the design performance.

There is also a bias from the memory effect due to the assessment limitations. It was necessary to evaluate the effectiveness of the use of the UCD model. Therefore, the method used was to compare the ideas generated before and after the use of the UCD model. However, it was difficult to be able to compare the ideas from different people. Therefore, it was necessary to design this way and claim this limitation.

Participant selection: Under the target (aim) of this research, an effort was made to improve the current design problems, namely non-UCD and incorrect UCD.

Therefore, the source of the participants was not confined. It was also found that the design practitioners have less knowledge than the designer researchers. However, it was not possible to find many results from the assessment to support this.

It is also necessary to register a limitation due to the background of the participants, and the reasons why it was not known what problems would occur before the tasks.

Firstly, implementation of the persona application software: technologies today change rapidly in mobile devices, which dramatically changes user behaviour. In addition, there is a political issue as Flash CS3 was not supported by Apple Inc. These changes have had a big impact and have given some uncertainty to the persona application software implementation. Therefore, in this research, a persona application software structure was integrated within the UCD model designed, instead of real software coding.

9.2. Future recommendations

Many assessments have been carried out to finish this work and the recommendations for the individual assessments have been listed in each chapter.

All the assessments can be grouped into two aspects of the process: to identify the problems and to solve the problems. Here, suggestions for these two categories are discussed:

- In the problem-finding process, it was simple to hire participants who are designer practitioners. However, amongst all the participants, there were no design researchers involved with this assessment. Therefore, it may be possible to identify the differences between design practitioners and designer researcher using specific attributes regarding the work of UCD. This may be an interesting point to work with.
- This research focused on UCD idea generation and, in the evaluation of the users, even though the results were acquired to support the UCD model to help user-centred idea generation, the research could be improved by developing the whole lifecycle of product design.

- A persona application software, integrated with the UCD model created, can carry out a detailed design so as to gather further results with the aim of UCD usage improvement.
- Persona creation can be a separate research topic and a further application software tool could make it closer to the real user research as well as the convenience of employment.
- The interaction of personas during idea generation can be investigated in more detail, such as how do the persona profiles affect idea generation? How does colour affect idea generation? Can a smiling photo help UCD idea generation?
- The application software can be extended to link with more functions rather than fictional personas. Such a linking of the profiles in an ergonomic user database may help designers in specialist fields, such as disability, the elderly or designing for safety.
- This research was focused on small budget businesses or individual design workers. However, a web-based application software design can be shared across departments and, therefore, it can increase usage in the UCD process.
- In this research, it was found that there was a lack of UCD training conducted during design education. A systematic course module in UCD is suggested for design education. It would help design practitioners improve their skills in user research.

References and bibliography

References list

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design.Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications, 37(4): 445-56.

Bevan, N., & Curson, I. (1999, May). Planning and implementing user-centred design. In CHI'99 extended abstracts on Human factors in computing systems :137-138. ACM.

Bevan, N. (2009). What is the difference between the purpose of usability and user experience evaluation methods. In UXEM'09 Workshop, INTERACT.

Beyer, H.; Holtzblatt, K. (1998) Contextual design: Defining Custom-Centered System, Morgan Kaufmann, San Francisco.

Bias, R. G., & Mayhew, D. J. (Eds.). (2005). Cost-justifying usability: An update for the Internet age. Morgan Kaufmann.

Bødker, S., et al. (1987). A Utopian experience: In G. Bjerknes, P. Ehn, & M. Kyng. (Eds.), Computers and democracy: A Scandinavian challenge :251–278. Aldershot, UK: Avebury.

Bødker, S. (2000). Scenarios in user-centred design—setting the stage for reflection and action. Interacting with computers, 13(1), 61-75.

Bullinger, H. J., Fähnrich, K. P., & Meiren, T. (2003). Service engineering—methodical development of new service products. International Journal of Production Economics, 85(3), 275-287.

Chen, R. C., Higget, N., & Nivala, W. C.(2009) The development of a conceptual model in user research using an empathic design technique as the basis for user-centred design.

Cooper, A. (1999). The inmates are running the asylum. Macmillan.

DIS, I. (2010). 9241-210: 2008. Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems (formerly known as 13407).International Organization for Standardization (ISO). Switzerland.

Dorothy L. & Rayport J.F. (1997). Spark Innovation Through Empathic Design. Boston: Harvard Business Review Nov-Dec 1997: 107.

Graham, D. (2004). Ideation: the birth and death of ideas.

Green, W. S., & Jordan, P. W. (Eds.). (2002). Pleasure with products: Beyond usability. CRC.

Grudin, J. and Pruitt, J. (2002) Personas, participatory design and product development: an Infrastructure for engagement. Paper presented at Participatory Design Conference 2002, Malmo, Sweden.

Grudin, J. (2006). Why personas work: The psychological evidence. The persona lifecycle: Keeping people in mind throughout the product design, 642-664.

Pruitt, J., & Adlin, T. (2006). The persona lifecycle: keeping people in mind throughout product design. Morgan Kaufmann.

Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., & Cajander, Å. (2003). Key principles for user-centred systems design. Behaviour and Information Technology, 22(6): 397-409.

Hitchcock, D., & Taylor, A. (2003). Simulation for Inclusion–true user centred design. In Include 2003 Conference Proceedings: 105-110.

Junior, W. K., & Guanabara, A. S. (2005). Methodology for product design based on the study of bionics. Materials & design, 26(2): 149-155.

Koskinen, I. (2003) Empathic Design – Users experience in product design, IT Press, Finland

Leonard, D., & Rayport, J. (1997). Spark innovation through empathic design. Harvard business review, 75: 102-115.

Mao, J. Y., Vredenburg, K., Smith, P. W., & Carey, T. (2005). The state of user-centered design practice. Communications of the ACM, 48(3): 105-109.

Nagamachi, M., Kansei Engineering.(1989), Tokyo: Kaibundo Publishing Co. Ltd.

Norman, D. (1988). The design of everyday things, Doubleday, New York. p188

Norman, D. (2003). Emotional design: Why we love (or hate) everyday things. Basic books.

Norman, D. (2005). Human-centered design considered harmful. Interactions, 12(4): 14-19.

Obrist, M., Roto, V., & Väänänen-Vainio-Mattila, K. (2009). User experience evaluation: do you know which method to use?. In Proceedings of the 27th international conference extended abstracts on Human factors in computing systems: 2763-2766. ACM.

Olsen, G. (2004). Persona creation and usage toolkit. Interaction by Design.[Online], 3, 2004. *Available from: http://darmano.typepad.com/for_blog/olsen_persona_toolkit.pdf [Accessed 12 July 2012].*

PriceWaterhouseCoopers. (2003). Innovation Survey. London: Price Waterhouse and Coopers & Lybrand.

Ránky P (1983). Computer integrated manufacturing. Prentice-Hall, Inc.

Rugg, G. and McGeorge, P. (1997). The sorting techniques: a tutorial paper on card sortis, picture sorts and item sorts. Expert Systems, 14(2):80 – 93.

Sakao, T., & Shimomura, Y. (2007). Service Engineering: a novel engineering discipline for producers to increase value combining service and product.Journal of Cleaner Production, 15(6), 590-604.

Sakao, T., Shimomura, Y., Sundin, E., & Comstock, M. (2009). Modeling design objects in CAD system for Service/Product Engineering. Computer-Aided Design, 41(3): 197-213

Spencer D. Card Sorting: Designing Usable Categories. Brooklyn, NY: Rosenfeld Media; 2009.

Steen, M., Kuijt-Evers, L., & Klok, J. (2007). Early user involvement in research and design projects–A review of methods and practices. In 23rd EGOS Colloquium, Vienna.

Tullis, T. and Wood, L. (2004). How many users are enough for a card-sorting study? In Proceedings UPA'2004, Minneapolis, MN.

Törpel, B. (2005, August). Participatory design: a multi-voiced effort. InProceedings of the 4th decennial conference on Critical computing: between sense and sensibility:177-181. ACM.

Ulrich, K. T. & Eppinger, S. D. (2012) Product Design and Development, fifth edition New York, McGraw- Hill.

van Kesteren, I. E., Bekker, M. M., Vermeeren, A. P., & Lloyd, P. A. (2003, July). Assessing usability evaluation methods on their effectiveness to elicit verbal comments from children subjects. In Proceedings of the 2003 conference on Interaction design and children: 41-49. ACM.

WEITZMAN, E. A. & MILES, M. B. (1995) Computer programs for qualitative data analysis. London, Sage

Bibliography

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design.Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications.

Bevan, N. (2009). Extending quality in use to provide a framework for usability measurement. Human Centered Design, 13-22.

Bias, R.G., 1994. The Pluralistic Usability Walkthrough: Coordinated Empathies. In Nielsen, J.& R.L. Mack (eds.), Usability inspection methods, NY, John Wiley & Sons, 63-76.

Bruseberg, A., & McDonagh-Philp, D. (2000, September). User-centred design research methods: the designer's perspective. In Integrating design education

beyond 2000 conference :179-184.

Cooper, A. (1999). The inmates are running the asylum. Macmillan

Carrol, J. M. (Ed.) (1995): ScenarioBased Design. London: John Wiley & Sons.

DIS, I. (2010). 9241-210: 2008. Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems (formerly known as 13407).International Organization for Standardization (ISO). Switzerland.

Garrett, J. J. (2002). Elements of User Experience: User-Centered Design for the Web. New Riders Press, USA.

Gladstein, G.A., 1983. Understanding empathy: integrating counseling, developmental, and social psychology perspec- tives. Journal of Counseling Psychology, 30 (4), 467–482.

Gould, J. D., Boies, S. J., & Ukelson, J. (1988). How to design usable systems. Handbook of human-computer interaction, 2, 231-54.

Grudin J. (2006). Why Personas Work – the psychological evidence. In the Persona Lifecycle, keeping people in mind throughout product design, Pruitt J & Adlin T (eds) Elsevier: 642 – 663

Kouprie, M., & Visser, F. S. (2009). A framework for empathy in design: stepping into and out of the user's life. Journal of Engineering Design, 20(5): 437-448.

Levi, M. D., & Conrad, F. G. (1997, March). Usability testing of world wide web sites. In Conference on Human Factors in Computing Systems: CHI'97 extended abstracts on Human factors in computing systems: looking to the future. Vol. 22, No. 27:227-227.

Linden, T., & Cybulski, J. L. (2003). Application of grounded theory to exploring multimedia design practices. Deakin University School of Information Systems

Lockwood, T. (2010). Design Thinking. Integrating Innovation, Customer Experience and Brand Value; Allworth Press: New York.

Lunenfeld, P. (2003). Design research: Methods and perspectives. B. Laurel (Ed.). MIT press.

Merzbacher, M., & Patterson, D. (2002). Measuring end-user availability on the web: Practical experience. In Dependable Systems and Networks, 2002. DSN 2002. Proceedings. International Conference on:473-477. IEEE.

Nielsen, J. (1993) Usability Engineering. San Francisco: Morgan Kaufmann.

Nielsen, J. (1994). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), Usability Inspection Methods (John Wiley & Sons, New York, NY).

Norgaard, M., & Hornbæk, K. (2006). What do usability evaluators do in practice?: an explorative study of think-aloud testing. In Symposium on Designing Interactive Systems: Proceedings of the 6 th conference on Designing Interactive systems. Vol. 26, No. 28: 209-218.

Pruitt, J., & Grudin, J. (2003). Personas: practice and theory. In Proceedings of Conference on designing for user experiences (pp. 1e15). ACM Press

Spencer D. Card Sorting: Designing Usable Categories. Brooklyn, NY: Rosenfeld Media; 2009.

Tullis, T., & Albert, W. (2008). Measuring the user experience: collecting, analyzing, and presenting usability metrics. Morgan Kaufmann.

Vasara, K. (2003). Introducing personas in a software project. Master's thesis, Helsinki University of Technology, Helsinki.

Vredenburg, K., Mao, J. Y., Smith, P. W., & Carey, T. (2002, April). A survey of user-centered design practice. In Proceedings of the SIGCHI conference on Human factors in computing systems: Changing our world, changing ourselves: 471-478. ACM.

Warfel, T., & Maurer, D. (2004). Card sorting: a definitive guide. Boxes and arrows.

Whitefield, A., Wilson, F., & Dowell, J. (1991). A framework for human factors evaluation. Behaviour & Information Technology, 10(1): 65-79.

Appendix I : Publications

The following pages will contain the publications as follows, and the full papers are also attached.

Publication 1:

Chen, Robert, Wen Nivala, and Chien-Bang Chen. "Modeling the role of empathic design engaged personas: an emotional design approach." Universal Access in Human-Computer Interaction. Users Diversity (2011): 22-31.

Publication 2:

Nivala, Wen, et al. "An investigation of a personas-based model assessment for experiencing user-centred design." Universal Access in Human-Computer Interaction. Users Diversity (2011): 98-107.

Publication 3:

Chen, R. C., Higget, N., & Nivala, W. C. The development of a conceptual model in user research using an empathic design technique as the basis for user-centred design.

Appendix I : Publication 1

Modeling the role of empathic design engaged personas: An emotional design approach

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Abstract. Norman suggested three dimensions of emotion to approach user-centred design to raise awareness of the importance of designing for users to achieve a higher level of satisfaction. In other words, the design should satisfy the user's emotional desires beyond usability. This opinion explains user-centred design more broadly. Companies, such as Apple and Microsoft, have already employed anthropologist to observe users' daily behaviour. Unfortunately, gathering information on users' needs is costly, time consuming and complex and has, therefore, become a barrier for designers. Additionally, most emotional design only covers shape design instead of all emotional aspects. There is little previous work devoted to tackling these problems. This research, therefore, proposed using empathic design with the assistance of personas as the main approach to emotional design. We first investigated the designers' current design pattern to explore the difficulties and problems. Next, personas were used to ascertain how they could help designers to engage in emotional design. Comparisons were then given to show the effectiveness of the proposed method. This study invited 16 designers to partake in this assessment. We explored how personas help designers in idea generations by using emotional design and some guidelines were suggested for future research.

Keywords: User –Centred Design (UCD), personas, empathic design.

1. Introduction

Today, user-centred design (UCD) is widely regarded as the design philosophy that defines how a design should be made by understanding the user's needs. In addition, the whole design process is examined iteratively to be user-centric by the guideline ISO 13407 to enhance the practice of UCD [1].

In the early years, the promotion of UCD was meant to solve the problems that had been encountered by some designs, those that were difficult to use and that frustrated users. Norman pointed out the guidelines for designers in his book, "The Design of Everyday Things", helping them to correctly design functions by considering the users [2]. However, he argued in his next book, "Emotional Design", that design should cover not only the cognitive parts but also human emotion. Therefore, he proposed three dimensions of emotion, visceral, behavioural and reflective, and suggested that designers should not neglect the role of the user's emotions when

designing [3]. In other words, design should be customised by taking both users' cognition and emotion into account. Jordan also has similar viewpoints. He suggested the "four pleasures", which are physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure [4]. In addition, the satisfaction in function and usability is not enough to make users feel pleasure at a higher level of satisfaction. Jordan's points also indicated that user-centred design could be more complete by the explanation of satisfaction in advance. Therefore, the design is not the argument of design by following "aesthetics" or "functionality"; the proportions of the design elements are subjective to users.

Nevertheless, UCD is now used more in large enterprises even though there are several approaches to achieving UCD, such as contextual design, participatory design and empathic design. The reason is because the involvement of users makes the design costly. Most designers have a problem in understanding users when faced with them since it needs a high level of skill to arbitrate the decisions among users in a meeting and a professional background to resolve the users' behaviour during observations. Consequently, empathic design focuses on more aspects for the designers in the early stages of design. In addition, although empathic design offers "observation" as the method, the key point is to understand the users. Therefore, we only adapt the meaning "understanding of users" as the basis. To ask designers to think and behave like users could be a comparatively cheap solution as there is no "real user" involvement. Hence, the researchers suggested a method based on empathic thinking in order to help designers in the early stages of design to promote the benefits of cost effectiveness that are easy to manipulate.

This paper aims to explore the use of empathic design mixed with personas in order to help designers in the early stages of design to undertake emotional design more easily, enabling it to be more cost and time efficient. By doing this, we can persuade more usage of emotional design. 16 designers were invited to evaluate the proposed model by two-phase experiments and the experiment methods were interviews, think-aloud protocols and video recording. More findings are discussed in the results and discussion section. Through this research, we found this proposed method helped designers in emotional design and future suggestions were given.

User-Centered Design: User-centered design (UCD) is a design concept first mentioned by Donald Norman (1990). The definition of UCD is as its name implies, design according to users' needs. Norman criticised many inadequate designs that surround us and highlighted how they discouraged users from using the products. The significant difference of UCD is that it aims to persuade designers that design should consider the users' needs during the whole design process rather than adjusting users to accommodate the products.

Even though more and more companies are aware of the advantages of UCD and believe UCD to be an important philosophy, the different properties of products mean that following UCD becomes a difficult task. The International Organisation for Standardisation (ISO) provides a framework in ISO13407. It suggests the human-centred design mechanism of the application and the evaluation. Although ISO 13407 offers a basic guideline for the interactive design process, it is not intended to specify the particular methods required to approach UCD. In addition, one of the major points in ISO13407 is the iterative structure of the design process, as shown in Figure 1. It clarifies how the design should consider the user during the whole process.

Appendix I : Publication 1

Modeling the role of empathic design engaged personas: An emotional design approach

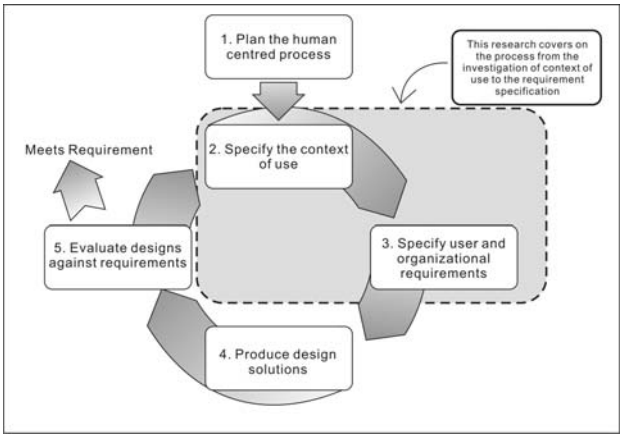

Fig. 1. The process of UCD and the area of this research [5]

Emotional Design: In "Design for Everyday Things", Norman admitted that user-centred design defines design by considering the user's wants. However, at that time he only considered that products"make sense". In other words, he only suggested the guidelines for cognitive thinking. Later, Norman proposed a supplement to this in his book "Emotional Design", which pointed out the important role played by human emotions when designing interactive products. The main points of emotional design are based on three levels of emotional processing: Visceral, Behavioural and Reflective.

As we can see from Figure 2, using this model we can easily reflect design elements according to emotional behaviour. In other words, different users may reflect their different desires on different aspects of design elements, such as aesthetics, functionality and usability. This can explain the reasons why some products that are difficult to use are still loved by some customers, whereas those that look good are more attractive to certain users.

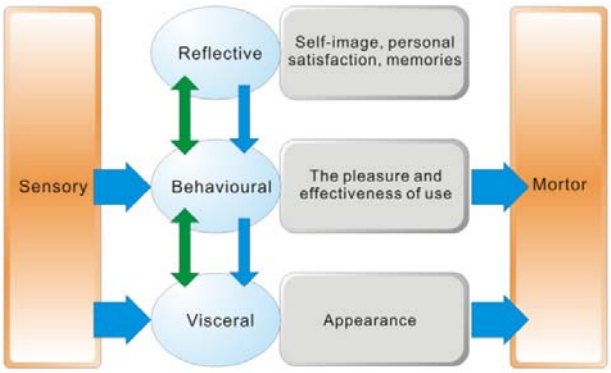

Fig. 2. The three-levels of human emotion reactions connected to the product characteristics.[3]

Empathic Design: This is an approach to UCD where the designer attempts to get closer to the lives and experiences of users and to apply the knowledge from end-users during the design process [5]. The goal of empathic design is to ensure that the product or service is designed to meet the needs of the end-users and is usable. Nevertheless, the users are only indirectly involved in the design project. It therefore tends to become 'designer-centred' instead of UCD. Additionally, professionals in empathic design promote the use of observation, although sometimes it is difficult to have the chance to freely observe the users in a particular situation. In addition to this, the involvement of users requires the design to need more skills and costs. Consequently, in this research, "personas" are used to overcome these issues and enhance the use of empathic design.

Personas: After Alan Cooper first promoted personas in his book, "The Inmates are Running the Asylum" [6], personas have been widely used in the computer science domain. Personas provide user profiles that can represent a group of people. The two main benefits of the use of personas are for communication between teams and to help designers to focus more on their users [7]. More findings, in terms of the use of personas, have been researched by Microsoft. In their work, they used personas to develop their popular software, such as "Office" and "Messenger", finding that the use of personas was a great benefit to design tasks. In addition, famous Japanese businesses are using them for organisation communication. The authors will use personas as the key technique and, inheriting many of the advantages from work previous to this research, we intend to investigate how personas can help a designer to develop their product concept in their individual work. This research will analyse the aspects that the individual designer can use to connect with emotional design, especially few scholars contributed in the area that the process of the use of personas with emotional design.

2. Methods

By reviewing the literature we will propose methods for this assessment. There will be a two-phase assessment. First is to investigate the current design pattern of the participants. The second will be to apply the proposed model to observe how designers conduct the idea generation. We will then compare the differences before and after the use of the persona-method to reach the conclusions.

2.1. The proposed method: empathic design with personas

We have arranged a two-phase experiment. In the first phase, we aim to survey designers' current design patterns. During the second phase, we will conduct the proposed method and then make comparisons in order to further evaluate the effectiveness. The plan of the experiment is showed in Figure 3.

Fig.3. The Illustration of the assessment plan

16 designers participated in the assessments. Even though this research can apply to various product categories, some control factors were defined in order to examine the comparable information in this assessment. Firstly, we assigned the same product in all the design tasks in which designers were asked to develop their product concepts. Additionally, the interviewees were required to have a similar background and to be able to manage the development of a design concept for a single product. Moreover, the designated task was confined to designing a product for use by an individual instead of a multi-user product. Also, the specified design task needed to cover all the elements of "appearance, function and usability". Each participant spent about 30 minutes undergoing interviews and the design tasks. A personal use product was specified to simplify the use of the personas. The design task needed to contain the appearance, function and usability in order to project the three emotional layers. Due to the criteria mentioned above a portable MP3 player for the group " ages 25-34, office ladies" were selected as the experimental task.

2.2. Phase I: The investigation of the current design pattern

During this phase, semi-structured interviews and think-aloud were undertaken in order to acquire details of the interviewee's background.

2.3. Phase II: The investigation of the use of the persona

The second phase is to introduce the personas in order to investigate how they can help with the design task. Before the task is examined, some assumptions are proposed: The designers are trained to have the design common sense to design and they are assumed to have the imagination for the operation of fictional characters. Otherwise, the participants and the target task remained the same as for the first phase.

The persona should be developed from the anthropology survey, except for the name and the photo, according to the previous literature. This is to avoid stereotyping a persona from familiar names and photos. Additionally, for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos from the FERET database (Figure 5. left side). The names were chosen from the most popular UK names on the website. The profile of the persona was taken from a lady who was located in our target market segment. Due to the limited task time available, the authors only assigned one persona, as the illustration on the right side of Figure 5. shows.

Task 2 took 10-15 minutes and the participants were asked to design, applying the same conditions as the first phase. The only difference was they needed to develop their concept using the specified persona provided. The persona is located within the same market segment, "25 to 34 year-old office ladies".The point of this research is

the investigation of the interaction between designers and the personas and the creation of personas is another big process.

3. Results and Discussion

3.1. The general background and the context of design from the interview

Thirteen of the designers were from Asia, two of them were from the UK and one was from the US. As we can see from Table 1 below, industrial designers were interviewed in the first and second phases. Within the group there were eleven senior designers with more than five years of work experience. Five of the group were junior designers with between six months and up to five years experience. The final group member was a senior design student who had only run independent design projects and group projects.

However, six designers felt that they needed to study the market on their own before they designed. Consequently, to avoid unfairness in the experiment, the researchers confined the task. We provided the same product information and only asked them to develop their product concepts.

Fig. 5. The left side is example photos from the FERET database. The right side is the persona in this task.

Furthermore, the designers were asked to describe their present methods of practising idea generation and their general design cycle for a project. Interestingly, when the question was asked, “Does the user matter in your design projects?”, only six of them answered “Yes”, whereas nine responded that they did specify users but tried to ensure the design covered all user groups in order to gain maximum benefits. This demonstrated the current design problems that designers were usually asked to do design greedy cover the market. The final participant believed that users were not important in their design. We also asked them how much they understood emotional design. Surprisingly, only one of them showed an understanding. Most of them either said they had never heard of it or they had heard of it but they did not exactly

understand the definition of emotional design. These patterns will be compared in the design task to see if the interview answers were identical to their design behaviour.

With regards to the design behaviour, several methods were used to inspire design ideas. Most of the designers tended to get the design concept by sketch, brainstorming and information gathering. Later, we gave them a design task that followed their current methods. Before doing this task, a question was asked in order to record whether they had designed a similar product before. Four of them had designed once for the same market segment and two of them had designed the same product. This information was taken in order to record whether their memory of the previous design affected and contributed towards any bias in the design process that we asked participants to do. We asked them to do the same task twice to compare how useful the personas were.

3.2. Results from Phase I: The investigation of the use of the persona

Table 2 shows how the designers developed their product concept using their current methods. As can be seen, six of them were product-centred, which means the designer only considered the product elements to make it pretty, regardless of the user. Three of the designers tended to be designer-centred with five tending to be both designer-centred and user-centred. Finally, two of the designers were user-centric but were easily distracted.

When analysing the interview results, we found that one of the weaknesses of the designers' present work is that, regardless of their experience, there was less user-centred design. When we examined the status of the user-centred designers, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another finding was that even though two of the designers said they had undertaken emotional design before, they actually regarded that "appearance design" meant emotional design.

Another drawback was that most of the designers were concerned with the design shape rather than functional design. Hence, we may summarise that the designers, without the support from a user research team, tended to ignore the users in their design.

Table 1. The background of the participants

Samples	Work Experiences[1]	Project Lifecycle[2]	Idea generation methods	Emotional design[3]
1	Senior	1-3m	Similar work gathering	C
2	Junior	1-3m	Brainstorming/Similar work gathering/ Scenarios/sketch	C
3	Junior	<5m	Similar work gathering/Sketch	A
4	Senior	1-3m	Brainstorming /Similar work gathering	C
5	Senior	1-3m	Sketch/Discussion/Similar work gathering	C
6	Senior	1m	Sketch	C
7	Junior	1m	Sketch	C
8	Student	1-2w	Sketch /User data gathering	C
9	Senior	3-5d	Sketch/ Brainstorming /User data gathering/ Similar work gathering/Sports	A

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10	Junior	1-3m	Sketch/ Brainstorming /User data gathering/ Similar work gathering	C
11	Senior	>6m	Sketch/ Brainstorming /User data gathering	C
12	Senior	1-2m	Sketch/ Brainstorming /User data gathering	C
13	Senior	2-3m	Sketch/ Brainstorming /User data gathering/ Similar work gathering	C
14	Senior	1-3m	Sketch/Brainstorming/User data gathering	C
15	Senior	1-4w	Sketch/Brainstorming/User data gathering	C
16	Senior	1-3m	Sketch	C

1

Table 2. The context of idea generations

Samples	Colour Scheme	Form	Special Functions?	Style/Tactile
1	Blue	Simple like an iPod	Wifi/ Convenient	Fashion
2	White with some pattern	Not specified	Not specified	Organic
3	Red or Pink	Sweet/ Stylish	Not Specified	Feminine and Elegant
4	Cannot decide now	Not specified	Simple MP3	Feminine
5	Black, to cover wider variety of users	Smooth/ Technology	Sound quality/Easy to play	Shiny surface for acceptance by the market
6	Pink series or multi-coloured mix	Round/ Delicate/ Match the dress	Simple keys	Elegant
7	Soft colour such as pink or white	Accessory	Friendly interface.	Plastic but metallic look
8	Red/Pink	Lipstick look	Simple buttons to operate	Shiny Plastic
9	Feel happy/pink series	Simple/Neat/Accessory	Easy interface and to charge up	Delicate/ Fashion
10	Many colour selections such as red/pink series	Simple/Clear	Can be used on the bus	Metallic
11	White series/ Shiny bright series/Pink series	Round/ Friendly/ Slim/Neat/ Easy to carry	Easy interface/ Shortcut to save files/ Rapid wireless to download albums	Rubber / Leather (soft feeling)
12	Silver +Black	Simple	Internet /Plug and Play and auto sorting	Metallic +Plastic
13	Cannot decide now (Multiple selection)	Simple like an iPod/ Square	Easy key/Touch panel	Plastic but metallic feeling

[1]*Work experience:
1. >5 years: Senior
2. <5 years: Junior
3.School project student[1]

2 Project Lifecycle:
m:Month
w: Week
d: Day

3 Emotional design?
A: I cam do it
B: I knew it *but I don't know* how to do it
C: I've never heard of it/ I've heard it but I don't know what it is.[1]

14	Pink/Feminine colour	Accessory to match the handbag	Bluetooth/Can have a mirror	Shiny/Plastic
15	Light pink	Curved	Not important	Comfortable
16	Silver and Green	Rectangular	DAB, Recorder/Subwoofer/Camera/Digital frame/ Lighter	Metallic and plastic

3.3. Results from Phase II: The investigation of the use of the persona

The design task followed the same conditions as the previous task. The results are shown in Table 3. As we can see in Table 3, when a persona is used, the design concepts from designers became similar in all aspects. However, they still had different ideas for their designs.

As shown by the information in the table and from interviews and observations, the designers were able to explore more design ideas. Additionally, the designers were found to use shorter timescales to make decisions. There might, however, be some errors attributed to the training effect due to the same product for the same users assigned to the same users twice. However, the supportive point from the interviews is that three of them had done the "MP3" project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when they were asked whether they felt the later concepts they made contradicted the previous task. All of the designers who were designer-centred and product-centred felt that the later designs were more likely to be suitable for the target users. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour domain or a specific colour.

Table 3. The context of idea generations by using the personas.

Samples	Colour Scheme	Form	Special Functions?	Style/Tactile
1	White	Like a T-shirt	Wifi/ Convenient	Clothes feel of material
2	Red	Rectangular/Small	Agenda/Reminder/Schedule/Inspired quote to cheer up her mood	Plastic
3	White	Organic	The ability to share functions with friends	Some pattern on the plastic
4	Monotone/Simple	Rectangular/ Bigger screen but lightweight	Touch panel/ Reminder/Easy operation/ Music download /Share	Soft Surface
5	White	Smooth/Portable	Easy/Good sound/Enough music storage	Shiny Surface
6	White	Round	Play/Radio	Plastic
7	Pink	Cosmetic box	Easy keys	Shiny Plastic
8	Pink	Lipstick	Simple play Earphone design resembles earrings	Plastic/Looks elegant
9	Cute Pink	Small/Portable /Rectangular	Update files easily	Fashionable/ Leather
10	Red/Black	Simple	As simple as it can be	Simple/Elegant and professional looking/ Metallic hair silky
11	Light bright colour	Round smooth/ Square	MP3/Recorder/ Calorie measurement	Shiny plastic/Metallic look
12	High contrast	Round	MP3/Photo viewer	Soft material

	colour with grey	smooth/ Square	Internet friendly/Upload and download friendly	
13	Pinky white with a flower pattern	Round smooth/ Square	Easy buttons with big touch screen/Photo Viewer/Sharing function	Shiny plastic
14	White with pink	Round smooth/ Square with curve for easier handhold	News/Music downloading from the internet	Soft on the back side for easy grasp/Shiny mirror screen
15	White with pink blue/red/orange /purple	Sportive	Calorie calculation Changeable cases for different moods	Soft material
16	Pink brown	Simple neat square	Small games to kill time	Soft material

Regarding the emotional design, here we listed an example from participant 4. As we can see from Figure 6, we can see the context of the design. Unlike most of the present emotional products in the market, this design can further touch the behaviour level of emotion rather than only "appearance design". This result is significant as it shows the mixed used of personas with empathic design can guide designers to reach empathic design without much training. Even if we only reviewed the interview data from participant 4, other participants showed similar results and we found that inspired ideas can connect to both the reflective and behavioural levels.

The designers would get a general image of this user by the photo, name and essential profiles, such as age and gender. Then they gave a rough appearance and sensory design. When the designer looked through the detail, they usually narrowed down the ideas in relation to the reflective part. Furthermore, they started to get inspiration from combinations of the details in order to provide a functional design, which is mapped to the behavioural level. However, we have no clues from the interview that they can do the visceral design by the provided personas.

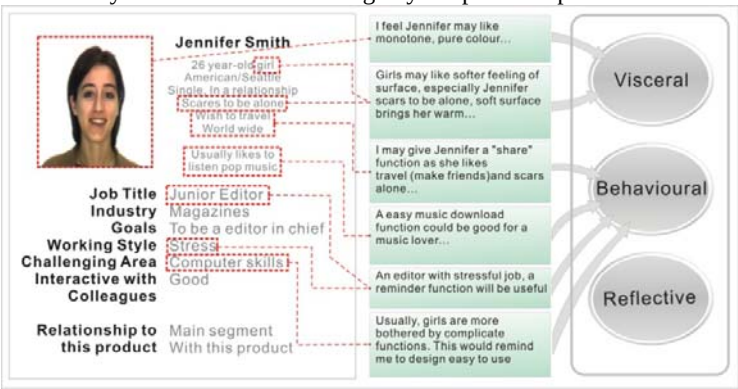

Fig. 6. The context of design in related to the persona

In general, the participants were satisfied with the use of personas and felt surprised at the effect of them. They commented that the personas did help them to think about users' emotion all the time without distraction. Also, they felt that this tool can help them towards self-communication and enable them to examine the ideas they made.

From the comparison of the task before and after the use of the persona, as we can see in Tables 2 and 3, we can see the design tendency converged to a similar colour domain in aesthetic design; functions are fruitful but still stick on the users. In addition, when designers undertook the task using the persona, they tended to design quicker and concentrate more.

4. Conclusions

We found the original design made it more difficult to approach user-centred design and, as a result, it was a less emotional design. In addition, most current emotional design only guides users to undertake appearance design. Instead, this method is able to lead designers to undertake emotional design without needing to be taught further design knowledge. This assessment provided the demonstration of the process of the idea generation engaged personas to launch emotional design.
In addition, this paper suggested that continuing on from this research, more characters of personas can be chosen to explore more evidences of how the personas engage with emotional design. Especially the visual personas and the profiles personas seem to provide different inspirations to designers. In addition, a complete product process can be undertaken to further assess the product with consumers.

5. Acknowledgment

We wish to thank the database provider, Face Recognition Technology (FERET).

6. References

1. ISO DIS 13407(1999). User-centred design process for interactive systems.
2. Norman, D. (1990). The design of everyday things, Doubleday, New York.
3. Norman, D. A. (2005). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Book.
4. Jordan, P.W. (2000). Designing Pleasurable Products: An Introduction to the New Human Factors. Taylor & Francis.
5. Bevan, N and Curson, L. (1999). Planning and implementing user-centred design, CHI, 1999, Adjunct proceedings Pittsburgh, ACM Press, New York, VS.
6. Koskinen, I. (2003). Empathic Design – Users experience in product design, IT Press, Finland.
7. Cooper, A. (1999). The inmates are running the asylum. Macmillan.
8. Grudin, J. and Pruitt, J. (2002). Personas, participatory design and product development: an infrastructure for engagement. Paper presented at the Participatory Design Conference 2002, Malmo, Sweden.

Appendix I : Publication 2

An investigation of a personas-based model assessment for experiencing User-centred design

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Abstract.
User-centred design (UCD) has been widely used to solve those failure products that are not proper designed for target users. Although UCD techniques are varies, some similar drawbacks were found as it requires complex skills to manipulate and it is time consuming as well as costly. Big enterprises have no problem with carrying out UCD because of rich resources. However, most of researchers made effort on the improvement of approaching UCD. Lack of studies contributed to the area of promotion UCD to those companies which do not launch UCD correctly or barely know UCD. Neither any of studies addressed on the investigation in difficulties those companies have and therefore helped them to be solved. Hence, this research aimed to assess a cost-effective UCD model to assist designers in idea generation.

16 designers were invited into the two-phase assessment. In addition, there were 51 end users as the participants to evaluate that if the designers who followed the proposed model can generate better UCD ideas. In this project, an MP3 was chosen because it is portable, easy, and with both aesthetics and functionality factors. In addition, 25-34 office workers were selected as the target users as the participants. This research was a whole process of the assessment of a cost-effective UCD model in assist designers' idea generation, and this assessment successfully showed that the cost-effective UCD model could eliminate the complex of the UCD skills and the cost, in which the UCD results were identified by the users. Therefore it could encourage more designers to apply UCD in their work. Further recommendations were also illustrated in this paper.

Keyword: User-centred design, personas, idea generation

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Robert C.C Chen1

1 Introduction

Today, user-centred design (UCD) is widely regarded as the design philosophy that defines how a design should be made by understanding the user's needs. In addition, the whole design process is examined iteratively to be user-centric by the guideline ISO 13407 to enhance the practice of UCD [1].

Nevertheless, UCD is now used more in only large enterprises even though there are several approaches to achieving UCD, such as contextual design, participatory design and empathic design. The difficulties for small-companies are as follow: the involvement of users makes the design costly; to understand the users' behaviour needs professional skills [2]; the design process is longer when users are involved.. Consequently, empathic design focuses on more aspects for helping the designers in the early stages of design. In addition, although empathic design offers "observation" as the method, the key point is to understand the users. Therefore, we adapt the meaning "understanding of users" as the basis of empathic design. Just to ask designers to think and behave like users could be a comparatively cheap solution as there is no "real user" involvement. Hence, the researchers suggested a model based on empathic thinking in order to help designers in the early stages of design to promote the benefits of cost effectiveness that are easy to manipulate. However, since there are no real users directly involved in the design process, we used the personas as "virtual users" to reinforce the engagement of designers and users in empathic design. Personas are usually used as a bridge for design communication [3]. And here they help designers to concentrate more when thinking about users.

Plenty of literatures addressed the creating of personas but none of them evaluate the effectiveness as this paper. Especially this paper focused on the encouraging UCD from non UCD designers, none of papers contributed in this area.

This paper aims to assess the use model to find out whether the model could help designers in design to undertake UCD more easily, enabling it to be more cost and time efficient. By doing this, we can persuade more usage of UCD.

There were 16 designers invited into the first two stage of assessment In the final stage, there were 51 end users as the participants to evaluate that if the designers who follow the proposed model can generate better UCD ideas. In this project, an MP3 was chosen because it is portable, easy, and with both aesthetics and functionality factors. In addition, 25-34 office ladies were selected as the target users. The evaluations from the target-users were also tested to evaluate if the proposed model can help designers in UCD idea generation.

The result showed the ideas generated by the proposed model were more likely chosen by target users. In another words, the model provided a user-centred guide for design practitioners. Besides, questionnaires from designers showed that designers' satisfaction of this proposed model has significantly high rate. This research therefore verified a personas-based model which can help designers work with UCD principal. Especially this model cut the research and design work into two parts and reduced the level of complexity of UCD. Hence this model can promote the use of UCD in the small companies or companies with small budget. The research constraints were given, as well as future suggestions.

Empathic Design: This is an approach to UCD where the designer attempts to get closer to the lives and experiences of users and to apply the knowledge from end-

users during the design process. The goal of empathic design is to ensure that the product or service is designed to meet the needs of the end-users and is usable. Nevertheless, the users are only indirectly involved in the design project. It therefore tends to become 'designer-centred' instead of UCD. Additionally, professionals in empathic design promote the use of observation [2], although sometimes it is difficult to have the chance to freely observe the users in a particular situation. In addition to this, the involvement of users requires the design to need more skills and costs. Consequently, in the proposed model, "personas" are used to overcome these issues and enhance the use of empathic design.

Personas: Since Alan Cooper [4] first promoted personas in his book, "The Inmates are Running the Asylum", personas have been widely used in the computer science domain. Personas provide user profiles that can represent a group of people. The two main benefits of the use of personas are for communication between teams and to help designers to focus more on their users. More findings, in terms of the use of personas, have been researched by Microsoft. In their work, they used personas to develop their popular software, such as "Office" and "Messenger", finding that the use of personas was a great benefit to design tasks. In addition, famous Japanese businesses are using them for organisation communication.

During this research, the authors used personas as the key technique and, inheriting many of the advantages from work previous to this research, we intend to investigate how personas can help a designer to develop their product concept in their individual work. In other words, this research will not concentrate on communication between teams, one of the biggest beneficial functions. Instead, this research will analyse the aspects that the individual designer can use to connect UCD. In addition, although plenty of research addressed the work of creating a persona, lack of literature addressed on the evaluation of the area where designers have less UCD experiences.

2 Methods

The aim of this study is to assess a cost-effective UCD model to benefit designers' idea generation in order to promote UCD to non-UCD designers. However, this model is also suitable to compensate general UCD design method when the user is not available. Additionally, there are two main objectives of this research:

1. To launch the proposed model and compare with the results before the use of the proposed model. In addition, the satisfaction of designers in using this proposed model will be surveyed by questionnaires.
2. To evaluate the effectiveness of the proposed model with preset target users. This is to access if the effective UCD model can actually be user-preferred.

Based on the objectives, we selected methods for two-phase assessments and a final UCD evaluation with preset target users. For the first objective, we tried to conduct the proposed model and compare the data after use proposed model and before. In addition, designers' satisfactions were survey and further expertise opinions were used to refine the model. The methods we selected here are the questionnaires and the think-aloud for the small design tasks.

The second objective was implemented from users' vision. We used the results of

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idea generation by designers to assess with the preset target users, who are the 25-34 office female workers.

The proposed model: empathic design with personas: As introduced in the previous sections, the empathic design focuses more in the early stage of design and would be a possible cost-effective method if we set the “virtual users” in this proposal. As we called “virtual users” here, is to differentiate between other UCD approaches In other words, we only took the idea of “empathic” to understand and think like the users instead of traditional observations from users. As a result, due to the lack of real user involvement, empathic design is an economic approach compared to participatory design and contextual design. In addition, we adapted the personas to reinforce the existence of the users.

Based on the concept above, Chen et al. [5] constructed the personas-based model. The model aimed to make personas be integrated into designers’ current work. Moreover, the use of personas and the creating of the personas were cut into two parts in order to make the proposed model more modularized to adjust the sequence of workflow when it is needs. The model also suggested making the creation of personas to be as simple as possible since practitioners have less research background. Also, the amount of personas can be acquired subjected to the need of designers. The other benefit from this model is that this model only tells designers to look the generated personas when each idea is generating. It does not need very complicated skill to manipulate. The model is shown in Figure 1.

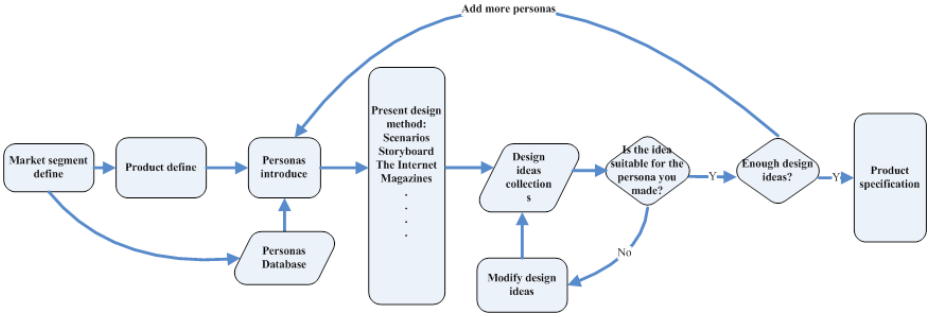

Fig.1.The demonstration of the cost-effective UCD model

The plan of the assessment with designers: Accordingly, we have arranged a two-phase assessment with designers and one assessment with end users. The purpose of the two-phase assessment is to get the generated ideas and compare them. Furthermore, the target users in the final evaluation will evaluate the idea set. The illustration of the two-phase plan is showed in Figure 2.

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Fig.2. The Illustration of the two-phase assessment with designers

We invited 16 designers to participate in the experiments. Even though this research can be relevant to various product categories, the researchers defined some control factors in order to examine the comparable information in this experiment. Firstly, we assigned the same product in all the design tasks in which designers were asked to develop their product concepts. Additionally, the participants were required to have a similar background and to be able to manage the development of a design concept for a single product. Moreover, the designated task was confined to designing a product for use by an individual instead of a multi-user product. Each designer-participant spent about 30 minutes undergoing interviews and the design tasks. Besides, the design task needed to contain the appearance, function and usability in order to project the three emotional layers.

The authors chose a portable MP3 player for the group “ages 25-34, office workers” as the experimental task. MP3 player is mostly for individual use. Some product such as a remote controller is a multi-user device, which will bring more complicated factors to the research. Therefore, a personal use product was specified to simplify the use of the personas.

Assessment phase I (The investigation of the current design pattern): In this task, we are going to examine whether the designers could focus on users to launch emotional design, and to find out the current design problems.

Assessment phase II (The investigation of the use of the model): The second phase is to introduce the personas-based model in order to investigate how they can help with the design task. Before the task is examined, some assumptions are proposed: The designers are trained to have the common design skills and they are assumed to have the imagination for the operation of fictional characters. Otherwise, the participants and the target task remained the same as for the first phase.

The persona should be developed from the anthropology survey, except for the name and the photo, according to the previous literature. This is to avoid stereotyping a persona from familiar names and photos. Additionally, for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos from the FERET database which is usually used in face recognition. The database captured various emotions from each person. Nevertheless, in this experiment, we only took smile face to link the emotional design as the example photos in Figure 3 left side.

The point of this research is the assessment of understanding designers’ current work of idea generation by the personas-based model for them to easily design for users. Therefore, this paper will focus the interaction between designers and the personas since there has been plenty of literature addressed the personas generation. Accordingly we simply followed the literature in order to generate a suitable persona. Olsen [6] offered the guidelines for creating personas and Pruitt and Adlin [3] provided more knowledge about personas in their book.

In terms of the photo, as the conditions of the tasks which specify the age and the gender, we randomly picked up a photo from the database above. Additionally, the names were chosen from the most popular UK names on the website. The profile of the persona was taken from a lady who was located in our target market segment. Due to the limited task time available, the authors only assigned one persona and assumed

this lady is the archetype of this group s the illustration on Figure 5.right side shows.

Task 2 took 10-15 minutes and the participants were asked to design, applying the same conditions as the first phase. The only difference was they needed to develop their concept using the specified persona provided. The persona is located within the same market segment, “25 to 34 year-old office female workers”.

Fig. 3. The left side is example photos from the FERET database. The right side is the persona in this task.

The plan of the evaluation with target users: This stage aims to evaluate the effectiveness of idea generation from the proposed model. This user group (25-34 office female workers) is the target when the designers do the design during the assessment. First, we grouped the ideas into two set, one set is the ideas generated before the use of the model; the other is the ideas after use of the proposed model. Next, we put the 16 sets of ideas of portable MP3 players randomly into the options. Then we invited the users to do the online questionnaires. The last part is to analyze the data to see which set of ideas were more preferred by these target users.

3 Results and Discussions

The industrial designers were interviewed in the first two stages. There were eleven senior designers with more than five years of work experience. Five of them were junior designers with between six months and up to five years experience.

However, six of the designers felt that they needed to study the market on their own before they designed. Consequently, to avoid unfairness in the experiment, the researchers further confined the task. We provided the same product information and only asked them to develop their product ideas.

Furthermore, the designers were asked to describe their current methods of practising idea generation and their general design cycle for a project. Interestingly, when the question was asked, “Does the user matter in your design projects?” only six of them answered “Yes”, whereas nine responded that they did specify users but tried to ensure the design covered all user groups in order to gain maximum benefits. This demonstrated the current design problems that designers were usually asked to do design greedy cover the market as a result they seems destructive and confused the

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real user group as we will see this phenomenon in the following design task. The final participant believed that users were not important in their design. We also asked them how much they understood emotional design. Surprisingly, only one of them showed an understanding. Most of them either said they had never heard of it or they had heard of it but they did not exactly understand the definition of emotional design. These patterns will be examined in the design task to see if the interview answers were identical to their design behaviour.

With regards to the design behaviour, several methods were used to inspire design ideas. Most of the designers tended to get the design concept by sketch, brainstorming and information gathering. Later, we gave them a design task that followed their current methods. Before doing this task, a question was asked in order to record whether they had designed a similar product before. Four of them had designed once for the same market segment and two of them had designed the same product. This information was taken in order to compare whether trained-effect factor contributed towards any bias in the design process that we asked participants to do.

One important data of this stage is to understand the difficulties of practising UCD. None of them said that they have not heard the principle of UCD. And within all these designers, they do not have experience of gathering real users to explorer their needs and responses. They reflected that the design projects were mostly doing without real users' involvements. This problem was blamed to the short design schedule and no extra cost was given for them to do this kind of user research. Some other difficulties of practising UCD will be revealed in the task in which designers were asked to generate their design ideas on their own.

Results from Phase I of the assessment (Before the use of the proposed model): This part of result shows how the designers developed their product concept before using the proposed model. As can be seen, six of them were product-centred, which means the designer only considered the product elements to make it pretty, regardless of the user. Three of the designers tended to be designer-centred with five tending to be both designer-centred and user-centred. Finally, two of the designers were user-centred, but were easily distracted. While the assessment of this task, the designers were asked to sketch only due to the limited of time and to make the process keep consistent for every designers.

When analysing the interview results, we found that one of the weaknesses of the designers' present work is that, regardless of their experience, there was less user-centred design. When we examined the status of the user-centred designers, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another finding was that even though two of the designers said they had undertaken emotional design before, they actually regarded that "appearance design" meant emotional design.

Another drawback was that most of the designers were concerned with the design shape rather than functional design. Hence, we may summarise that the designers, without the support from a user research team, tended to ignore the users in their design.

Results from Phase II (The investigation of the use of the model): The design task followed the same conditions as the previous task.From interviews and observations, the designers were able to explore more design ideas. Additionally, the designers were

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found to use shorter timescales to make decisions. There might, however, be some errors attributed to the training effect due to the same product for the same users assigned to the same designers twice. However, the supportive point from the interviews is that three of them had done the "MP3" project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when they were asked whether they felt the later concepts they made contradicted the previous task. All of the designers who were designer-centred and product-centred felt that the later designs were more likely to be suitable for the 25-34 year-old office female workers. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour domain or a specific colour.

The designers would get a general image of this user by the photo, name and essential profiles, such as age and gender. Then they gave a rough appearance and sensory design. When the designer looked through the detail, they usually narrowed down the ideas in relation to the reflective part. Furthermore, they started to get inspiration from combinations of the details in order to provide a functional design, which is mapped to the behavioural level. However, we have no clues from the interview that they can do the visceral design by the provided personas.

In general, the participants were satisfied with the use of personas and felt surprised at the effect of them. They commented that the personas did help them to think about users' emotion all the time without distraction. Also, they felt that this tool can help them towards self-communication and enable them to examine the ideas they made.
From the comparison of the task before and after the use of the persona, we can see the design tendency converged to a similar colour domain in aesthetic design. Regarding to functional design, ideas are fruitful but still stick on the users. In addition, when designers undertook the task using the persona, they tended to design quicker and concentrate more.

Furthermore, by conducting the phase II, we got an impressive finding in this experiment. This proposed method not only reached to empathic design, but also, designers do not need to be trained for this method. Even they do not know much about the theoretical part.

Results from the evaluation with users: There were 51 effective answered from online questionnaires, and all of them are Taiwanese office ladies with the age from 25-34. We labelled answered set of ideas into two categories: Proposed Model (A) vs. Original Design (B). And there were 16 sets of ideas from 16 designers designed before and after (the use of the proposed mode). The original data of sixteen sets from were shown in Table 1.

Table 1. The votes from target users

No. of designers' idea set	*Vote counts from 51 preset target users* *A (ideas generated by using the proposed model*	*Vote counts from 51 preset target users* *B (Original ideas)*
1	28	23
2	23	28

3	38	13
4	44	17
5	37	14
6	41	10
7	44	7
8	26	15
9	14	37
10	30	21
11	15	26
12	33	18
13	25	26
14	39	13
15	33	18
16	20	31

We used the paired-T test to analyze if the data is oriented to Group A (idea generated by using the proposed model). And the result shows most of the target users preferred the ideas generated by user-centred model as shown in Table 2 and Table 3.

Table 2. Paired Sample Statistics

	Mean	***N***	***Std Deviation***	***Std Error***
Group A	30.25	16	9.191	2.298
Group B	19.19	16	8.758	2.189

Table 3. Paired Sample Test

	Paired Differences							
				95% confidence Interval of the difference				
	Mean	Std D	Std Err	Lower	Upper	*1*	*df*	*Sig(2-tailed)*
Paired A-B	**11.063**	**17.582**	**4.396**	**1.694**	**20.431**	**2.517**	**15**	**.024**

These results show that even the idea generation by the proposed model is just a short time test. The model still can bring significant effect to the design work. And therefore the evaluation of the work made this research more complete.

Research limitations:

Some constrains were existed in this studies. First, the duration of task arrangement is limited, that may lead designers to design not as well as they usually do. Additionally the short period of time made the ideas less concreted. Second, the designers were asked to use one of their current design methods: sketch. Sketch is the most common

skill of designers and hence it is good for the comparison in this assessment. However, some of the designers may tend to use more method to benefit their idea generation. Hence this part may contribute the bias of this task assessment.

4 Conclusions & Recommendations

In phase I, we found that during the original design, the design is easily distracted from users. And the assessment from designers showed the high satisfaction of using the proposed model. Besides, when evaluated the idea generation, the statistical results showed that the ideas generated by interacting with users were more attractive to the preset target users. This model is able to lead non-UCD designers to undertake UCD without needing to be taught further design knowledge as well as to design both aesthetics and functions.

Continuing on from this research, the authors would suggest to develop a CAD tool to assist the use of and collection of personas, since most designers have difficulties of generating personas. Therefore, this research suggested putting the personas generation separately. And the CAD may rise the willing of use.

5 Acknowledgment

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6 References

1. Bevan, N and Curson, L. (1999). *Planning and implementing user-centred design*, CHI, 1999, Adjunct proceedings Pittsburgh, ACM Press, New York, VS.
2. Koskinen, I. (2003). *Empathic Design – Users experience in product design*, IT Press, Finland.
3. Grudin, J. and Pruitt, J. (2002). *Personas, participatory design and product development: an infrastructure for engagement*. Paper presented at the Participatory Design Conference 2002, Malmo, Sweden.
4. Cooper, A. (1999). *The inmates are running the asylum*. Macmillan.
5. Chen et al. (2009), in Proceedings of 3rd IASDR 2009 on Design, Rigor & Relevance.
6. Olsen, G. (2004). Persona Creation and Usage Toolkit.Retrieved August 3, 2001, from : http://www.interactionbydesign.com/presentations/olsen_persona_toolkit.pdf.

Appendix I : Publication 3

The development of a conceptual model in user research using an empathic design technique as the basis for user-centred design

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Abstract: There has recently been more awareness of user-centred design (UCD) due to instances of poorly designed products that are used in our daily lives. In order to improve the usability of products, many methods have been suggested to approach UCD. However, encouraging users into the design process encountered many difficulties. The two main problems in realising UCD were addressing the techniques of coordinating UCD meetings and the longer development cycle. Consequently, the practice of UCD principles is considered costly. This research aims to develop an economic model, based on empathic design, in order to support designers to develop their design concepts with a better understanding of the user. Firstly, this research investigated concept development. Secondly, a theoretical model was then proposed and, finally, this was assessed. In the first two stages, twenty designers were invited to construct the model while five more experts helped with the assessment. This research was concluded with a conceptual model which allows integration with a designer's individual design work.

Keywords: user-centred design (UCD), empathic design, personas

1. Introduction

1.1 Background

In our daily lives, our interaction has increased with various products that have more and more sophisticated functions. In addition, most products are required to satisfy a diverse range of users. It has been pointed out by Norman [8] that inadequately designed objects may not only induce negative emotions from the user but also sometimes put the user in a dangerous situation. To cope with this, a design philosophy, user-centred design (UCD), is promoted. UCD means that the design is based on the needs of the user [8].

Several methods can be conducted to realise a UCD including contextual design, participatory design and empathic design. ISO13407 [6], provides guidelines for the whole product process. In particular, it suggests inviting product users to join in with the whole design process. However, in practise, this is costly and time consuming. The drawbacks are mainly in two areas; the highly difficult technique of coordinating a UCD meeting and the long process of product development. As a result, participatory design and contextual design may not be suitable for a firm with a limited budget that wants to employ a UCD approach. Since it is necessary to hire real users to participate in the design process, it is important to have a good understanding of human behaviour. For instance, large companies such as Apple, Motorola and Microsoft have already integrated anthropologists into their personnel in order to make their designs match their user's needs [2]. However,

most small businesses do not have the budget to employ such professionals in their user research areas. In other words, gathering information on the needs of the consumer is costly and would be rarely used by small-scale enterprises. Consequently, empathic design is proposed as an alternative approach to UCD.

To achieve empathic design, products must still be developed taking the needs of the end-user's into consideration [4]. However, the key benefit is that designers can improve the design by using their imagination to become a user themselves. Additionally, the initial stage of the design process is user research and it is in this area where empathic design can be used the most. By using empathic design, UCD can reduce the product testing time, thereby successfully saving the product developer time and expense. By promoting empathic design to designers, it not only improves the product but might also change the behaviour of the design industry, due to the benefits of a cheaper method for designers to approach UCD.

In this paper, the authors introduce 'personas' as the main method of aiding a designer to use empathic design. Personas are defined as fictional characters used to represent the users of a product. Experts believe they are useful tools that can be used as a bridge for team communication. Additionally, they also bring other benefits, such as raising the focus of users. In our research, personas were used to construct a conceptual model to help designers perform their individual tasks. The advantage of using personas was investigated by this experiment.

Firstly, the authors look at the related work, including UCD, empathic design and the use of personas. Secondly, the methodology for the study is presented. The methods used in the experiments were semi-structured interviews, think-aloud protocols and observations. Twenty participants were tested in the first two phases. Consequently, the model was then preliminarily constructed and five experts were invited to assess it. The key research outcomes present a refined, economical conceptual model along with a few recommendations for future research.

1.2 Literature Review

User-Centred Design (UCD): User-centred design, which is often abbreviated to "UCD", is a design philosophy, focusing on design work that is based on the needs of the user. By following this concept throughout the whole design process, the product can be made more usable and understandable for the user [8]. The major difference between UCD and other design philosophies is that UCD attempts to optimise the user interface around how people can, want or need to work, rather than forcing people to change how they work to accommodate the system or function. Since more and more companies are now aware of the importance and benefits of UCD, they are also interested in designing objects which are close to the needs of end-users. Nevertheless, the products are various and the organisation of every enterprise may be different. Therefore, following UCD becomes a challenging task. In 1999, the International Organisation for Standardisation (ISO) formalised the process of UCD with ISO 13407. This provides a framework for applying human-centred design and evaluation techniques and is intended to supplement existing lifecycle models [1].Although ISO 13407 specifies the type of activities to be performed during the development of an interactive system, it does not demand nor recommend particular techniques or methods [1]. Consequently, various approaches have been proposed to achieve UCD. The three main methods are participatory design, contextual design and empathic

design.

Participatory Design (PD): PD originated from Scandinavia in the 70s. This method promotes the idea that users should be involved in the design project throughout the whole design process. Moreover, it focuses on the equal footing between designers and users; in other words, it is a type of democratic thinking that encourages design decisions to be made cooperatively by users and designers. Due to the nature of PD, the lifecycle of the design process is usually quite long. In addition, because sometimes the user does not understand their own needs, the designer is still the interpreter between the user and the product [4]. As a result, the skills of designers are still a key factor for product development.

Contextual design (CD): Contextual design was developed by Hugh Beyer and Karen Holtzblatt in 1998. It adapts the idea in participatory design which invites users to take part in design activities. Additionally, it describes how great product ideas come from the integration of and detailed understanding of a customer's needs, with an in-depth understanding of technology [2]. Therefore, CD begins by understanding how customers work by observing their context of use that is called "contextual inquiry". It also incorporates anthropology to enhance the recognition of customer behaviour and forms a platform to help cross-functional teams to explore the actual needs of the customer.

Empathic Design: This is an approach to UCD where the designer attempts to get closer to the lives and experiences of users and to apply the knowledge from end-users in the design process, in terms of empathic design [4]. The goal of empathic design is to ensure that the product or service designed meets the needs of the end-users and is usable [4].Nevertheless, the users are indirectly involved in the design project. It therefore tends to become 'designer-centred' instead of UCD. Additionally, the professionals in empathic design promote the use of observation although sometimes it is difficult to have the chance to freely observe the users in a particular situation. Consequently, in this research, "personas" are used to overcome these issues and enhance the use of empathic design.

Personas: Personas have been widely used in the computer science domain since Alan Cooper [3] first promoted them in his book, "The Inmates are Running the Asylum". Personas depict various types of real users who can represent a group of people. The two main benefits of the use of personas are for communication between teams and helping designers to focus more on their users [5]. More findings, in terms of the use of personas, have been researched by Microsoft. In their work, they used personas to develop their popular software, such as "Office" and "Messenger", and found that the use of personas were a great benefit to design tasks. However, even here, the authors also use personas as the key technique and, inheriting many of the advantages from work previous to this research, we intend to investigate how personas can help a designer to develop their product concept in their individual work. In other words, this research will not concentrate on communications between teams, one of the biggest beneficial functions. Instead, this study will investigate the aspects which help the individual designer to work.

2. Methodology

The goal of this research is to develop a conceptual model to enhance the abilities of the designer in user research. To achieve this, the specified objectives are to explore the design context of the designer and to evaluate the theoretical model. According to the objectives, the research plan is divided into three phases: Phase one is the investigation into the designers' context of concept development; Phase two is the introduction of the personas into design tasks; Phase three is the construction and the evaluation of the conceptual model . The purpose of the first two phases is to develop the conceptual model. The final stage is for the evaluation of the model and recommendations. The detailed experiment will be explained later.

Although this research is relevant to various product categories, in order to examine the comparable information in this experiment, the researchers defined some control factors. Firstly, we assigned the same product in all the design tasks in which designers were asked to develop their product concepts. Additionally, the interviewees were asked to have a similar background and to be able to manage the development of their design concept for a single product. Moreover, the designated task was confined to designing a product for use by an individual instead of a multi-user product. Also, the specified design task needed to cover all the elements in "form and function".

2.1 Phase 1 - The investigation into designers' context of design

The purpose of phase 1 is to explore the problems and weaknesses of the present design work in user research and concept development. In this phase, designers with an industrial design background were invited to take part in the test. The interview process took about 30 minutes. A portable device for personal use was specified to simplify the use of the personas. The authors chose "MP3 player for the group: 25-34 office ladies" for the experimental task.

During this phase, semi-structured interviews were undertaken in order to acquire details of the interviewee's background. In addition, think-aloud protocols (TAP) were applied in which the users were asked to say whatever they were thinking, doing and feeling as they underwent their task. Furthermore, we also noted the technique "observations" in order to analyse the design tasks. In addition, the authors used NVivo to analyse the qualitative results, which were found to be useful in finding a pattern using the efficient coding method. NVivo is a popular and significant software package for organising and analysing qualitative data. By coding and analysing the subsequent pattern, a test theory can be built [9].

2.2 Phase 2 - The introduction of the personas into design tasks

The second phase is to introduce the personas in order to investigate how the personas can help with the design task. Before the task is examined, some assumptions are proposed: The designers are trained to have the essential knowledge for design and they are assumed to have the imagination for the fictional character operation. Otherwise, the participants and the target task remained the same as for the first phase.

The persona should be developed from the anthropology survey, except for the name and the photos, according to the previous literature. This is to avoid stereotyping a persona from familiar names and photos. Additionally, for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos

from the FERET database (Figure.1 the left side). The names were chosen from the most popular names on the website. The profile of the persona was taken from a lady who was located in our target market segment. Due to the limited time available, the author only assigned one persona, as the illustration in the right side of Figure.2 shows.

Figure.1 The left side is example photos from the FERET database. The right side is the persona in this task.

Task 2 took 10-15 minutes and the participants were asked to design applying the same conditions as the first phase. The only difference was they needed to develop their concept using a specified persona provided. The persona is located within the same market segment, 25 to 34 year-old office ladies. The process launched think-aloud protocols to gather data. Additionally, semi-structured interviews were used to reveal the options for building the conceptual model in the next phase.

2.3 Phase 3 - The construction of the theoretical model

In the last phase, the author proposes a conceptual mode for designers. Five more experienced participants were invited to help assess and refine the model. The participants in this phase were asked to design a product following the proposed model. The conditions of the design tasks were the same as the previous tasks in phases 1 and 2.

3. Results and Discussions

3.1 Phase 1

The context of the present design: We used NVivo as the tool to transcribe and code the information. Thirteen of the designers were from Asia, six of them were from Europe and one was from the US. As we can see from table 1 below, industrial designers were interviewed in the first and second phases. Within the group there were thirteen senior designers with more than five years of work experience. Five of the group were junior designers with between six months and up to five years experience. The final group member was a senior design student who had only run independent design projects and group projects.However, six of the designers felt that they needed to study the market on their own before they design. Consequently, to avoid unfairness in the experiment, the researchers provided the same product information and only asked them to develop their product ideas.

Furthermore, the designers were asked to describe their present methods of practising design and their general

design cycle for a project. Interestingly, when the question was asked, “Does the user matter in your design projects?” only nine of them answered “Yes”, whereas ten responded that they did specify users but tried to ensure the design covered all user groups in order to gain maximum benefits. The final participant believed that users were not important in their design. This pattern will be compared in the design task to see if the interview answers were identical to their design behaviour.

The project cycle, on average, takes between one and three months. With regards to the design behaviour, several methods were used to inspire design ideas. Most of the designers tended to get the design concept by sketch, brainstorming and information gathering.

Design Task Analysis (before and after the use of persona): Table 2 shows how the designers developed their product concept. As can be seen, seven of them were product-centred, which means the designer only considered the shape, regardless of the user. Three of the designers tended to be designer-centred with five tending to be both designer-centred and user-centred. Finally, five of the designers were UCD but were easily distracted.

When analysing the interview results, we found that one of the weaknesses of the designers’ present work is that, regardless of their experience, there was less user-centred design. When we examined the status of the user-centred designers, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another drawback was that most designers were concerned with the design shape rather than functional design. Hence, we may summarise that the designers, without the support from a user research team, tended to ignore the users in their design.

As shown in Table3. and from interviews and observations, the designers were able to explore more design ideas. Additionally, the designers were found to use shorter timescales to make decisions. There might, however, be some errors attributed to the training effect, due to the same product for the same users assigned to the same users twice. Nevertheless, the supportive point from the interviews is that three of them had done the “MP3” project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when they were asked whether they felt the later concepts they made contradicted the previous task. All of those designers who were designer-centred and product centred felt that the later designs were more likely to be suitable for the 24-35 year-old office ladies. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour domain to red.

Nevertheless, the participants highlighted concerns which included the fact that the use of personas may make the product too personal and cause the failure of a market approach. Also, personas are difficult to collect. Moreover, designers concerned that only one persona may narrow the market. After we provided more personas for them to select from, they all felt satisfied and the worry of the representation of the personas was eliminated.

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Table 1. The background of the participants

Samples	Academic Background	Work Experience*	Job function	Project Lifecycle*	User Centred?	General design behaviour	Note
1	Yes	Senior	Design	1-3m	B	Similar work gathering	*Work experience: 1. >5 years: Senior 2. <5 years: Junior 3.School project student *Project Lifecycle: m: Month w: Week d: Day *User Centred? A: Design will consider users B: Try to cover all users C: User is not considered in my design
2	Yes	Junior	Design	1-3m	B	Brainstorming/Similar work gathering/ Scenarios/sketch	
3	Yes	Junior	Design	<5m	A	Similar work gathering/Sketch	
4	No	Senior	Design	1-3m	A	Brainstorming /Similar work gathering	
5	Yes	Senior	Design	1-3m	B	Sketch/Discussion/Similar work gathering	
6	Yes	Senior	Design	1m	C	Sketch	
7	Yes	Junior	Design	1m	B	Sketch	
8	Yes	Student	Design	1-2w	B	Sketch /User data gathering	
9	Yes	Senior	Design+ Marketing	3-5d	B	Sketch/ Brainstorming /User data gathering/ Similar work gathering/ Sports	
10	Yes	Junior	Design+ Marketing	1-3m	A	Sketch/ Brainstorming /User data gathering/ Similar work gathering	
11	Yes	Senior	Design+ Marketing	>6m	B	Sketch/ Brainstorming /User data gathering	
12	Yes	Senior	Design+ Marketing	1-2m	A	Sketch/ Brainstorming /User data gathering	
13	Yes	Senior	Design	2-3m	B	Sketch/ Brainstorming /User data gathering/ Similar work gathering	
14	Yes	Senior	Design+ Marketing	1-3m	A	Sketch/Brainstorming/User data gathering	
15	Yes	Senior	Design	1-4w	A	Sketch/Brainstorming/User data gathering	
16	Yes	Senior	Design	1-3m	B	Sketch	
17	Yes	Senior	Design+ Marketing	1-3m	A	Inspiration from different product areas/ Similar work gathering/Sketch/Brainstorming	
18	Yes	Junior	Design	1-4w	A	Similar work gathering/Sketch/Brainstorming	
19	Yes	Senior	Design	1-2m	A	Marketing trend surveys/User data gathering/Sketch	
20	Yes	Senior	Design	1-3m	B	Similar work gathering/Brainstorming/Sketch	

Table 2. The design behaviour of the participants

Samples	Design Tendency	Colour Scheme	Form	Special Functions?	Style/Tactile	Note
1	Product Centred	Blue	Simple like an iPod	Wifi/ Convenient	Fashion	Design Tendency: To observe the respondents design behaviour. 1.Product Centred: Designer cares about the shape more than about the user 2. Designer Centred: Designer uses themselves as the user to approach the design 3. Designer Centred + *UCD The designers design by UCD, but after a few minutes, they become designer-centred. The research asks them why they change. They then realise they are designer-centred when asked "is this element for 25-34 year-old office ladies?" 4. *User centred: Designers consider the user in their design but easily get distracted (They can be UCD when asked "why did they give this element?"
2	Designer Centred + *UCD	White with some pattern	Not specified	Not specified	Organic	
3	Designer Centred	Red or Pink	Sweet/ Stylish	Not Specified	Feminine and Elegant	
4	Product Centred	Cannot decide now	Not specified	Simple MP3	Feminine	
5	Designer Centred	Black, to cover wider variety of users	Smooth/ Technology	Sound quality/Easy to play	Shiny surface for acceptance by the market	
6	Product Centred	Pink series or multi-coloured mix	Round/ Delicate/ Match the dress	Simple keys	Elegant	
7	Designer Centred + *UCD	Soft colour such as pink or white	Accessory	Friendly interface.	Plastic but metallic look	
8	Product Centred	Red/Pink	Lipstick look	Simple buttons to operate	Shiny Plastic	
9	Designer Centred + *UCD	Feel happy/pink series	Simple/Neat/ Accessory	/Easy interface and to charge up	Delicate/ Fashion	
10	* UCD	Many colour selections such as red/pink series	Simple/Clear	Can be used on the bus	Metallic	
11	Product Centred	White series/ Shiny bright series/Pink series	Round/ Friendly/ Slim/Neat/ Easy to carry	Easy interface/ Shortcut to save files/ Rapid wireless to download albums	Rubber / Leather (soft feeling)	
12	Designer Centred +*UCD	Silver +Black	Simple	Internet /Plug and Play and auto sorting	Metallic +Plastic	
13	Designer Centred	Cannot decide now (Multiple selection)	Simple like an iPod/ Square	Easy key/Touch panel	Plastic but metallic feeling	
14	Designer Centred + *UCD	Pink/Feminine colour	Accessory to match the handbag	Bluetooth/Can have a mirror	Shiny/Plastic	
15	*UCD	Light pink	Curved	Not important	Comfortable	
16	Product Centred	Silver and Green	Rectangular	DAB, Recorder/Subwoofer/ Camera/Digital frame/ Lighter	Metallic and plastic	
17	*UCD	Luxurious/Elegant	Smooth	Simple	Soft/ Comfortable	
18	Designer Centred + *UCD	Simple	Simple	Easy to share with friends/Easy download	Not specified	
19	*UCD	Fashion colour	Shaped like perfume/ Accessory	Not specified	Feminine	
20	*UCD	Bright colour/Yellow	Round /Funny shape	Earphone match the MP3	Cute/Plastic	

Table 3. The design behaviour of the participants using the personas.

Samples	Colour Scheme	Form	Special Functions?	Style/Tactile
1	White	Like a T-shirt	Wifi/ Convenient	Clothes feel of material
2	Red	Rectangular/Small	Agenda/Reminder/Schedule/Inspired quote to cheer up her mood	Plastic
3	White	Organic	The ability to share functions with friends	Some pattern on the plastic
4	Monotone/Simple	Rectangular/ Bigger screen but lightweight	Touch panel/ Reminder/Easy operation/ Music download /Share	Soft Surface
5	White	Smooth/Portable	Easy/Good sound/Enough music storage	Shiny Surface
6	White	Round	Play/Radio	Plastic
7	Pink	Cosmetic box	Easy keys	Shiny Plastic
8	Pink	Lipstick	Simple play Earphone design resembles earrings	Plastic/Looks elegant
9	Cute Pink	Small/Portable/ Rectangular	Update files easily	Fashionable/ Leather
10	Red/Black	Simple	As simple as it can be	Simple/Elegant and professional looking/ Metallic hair silky
11	Light bright colour	Round smooth/ Square	MP3/Recorder/ Calorie measurement	Shiny plastic/Metallic look
12	High contrast colour with grey	Round smooth/ Square	MP3/Photo viewer Internet friendly/Upload and download friendly	Soft material
13	Pinky white with a flower pattern	Round smooth/ Square	Easy buttons with big touch screen/Photo Viewer/Sharing function	Shiny plastic
14	White with pink	Round smooth/ Square with curve for easier handhold	News/Music downloading from the internet	Soft on the back side for easy grasp/Shiny mirror screen
15	White with pink blue/red/orange /purple	Sportive	Calorie calculation Changeable cases for different moods	Soft material
16	Pink brown	Simple neat square	Small games to kill time	Soft material
17	White with Silver	Simple neat square	Simple	Comfortable
18	Light/Soft colour	Lightweight smooth square	Easy to keep notes	Not easy to get dirty/Shiny plastic
19	Red with black	Rectangular with feminine curves	Contact detail/reminder/ Photo viewer	Shiny plastic
20	Pink	Organic/ Interesting form	Can share music and photos with friends	Soft plastic

3.3 Phase 3:

The evaluation of the model: As can be seen in Figure 2, the model is concluded from the previous phases, with these points as follows:

1. To employ personas as the basis to construct their product concepts.
2. Multi-personas are used to eliminate the bias of using only one persona.
3. The personas can be used within their present design work.

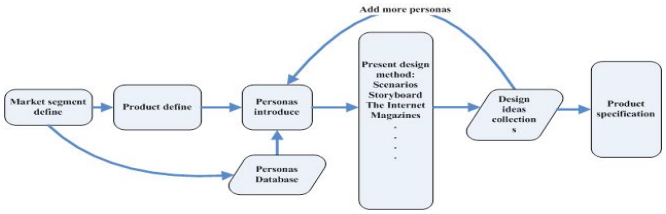


Figure 2: The concept model for development of design concepts

After the evaluation, the five designers gave the following comments.

1. The model is found to be systematic, but needs training and time to practise.
2. The personas help with the decision making but, after specifying the personas, the ideas are narrowed.
3. Designers can be inspired by the information that comes with using the personas but too many personas make the ideas more diverse.
4. Designers found it difficult to build a persona and suggested the researchers develop a CAD to help with this work.

3.4 The refined conceptual model

After phase 3, we modified the model with the suggestions made by the senior designers. Figure 4 demonstrates

the flow from the given product task to the specifications of the end product. The detailed ideas are as follows:

1. After the project is defined, the stakeholder can introduce the personas into the design work.
2. The personas are located within the market segment.
3. Cooperation with the present design tools: Most designers have their own favourite way to assist the creation of their ideas. The personas do not conflict with any of the present tools. Instead, this research suggests that designers imagine themselves as the personas and within various scenarios, interact with the tools they use.
4. After the collection of design ideas, the stakeholder may face two difficulties. Firstly, they may worry that the use of one persona may bring bias into the design. Additionally, focusing on the persona may lead to insufficient design ideas. This study proposes a procedure to check for this. The first is to check whether the design idea created is suitable for the persona. In other words, this check ensures the design is a UCD. The second is to check whether enough ideas are created or whether the designers should decide to employ more personas to complete the design ideas.
5. The personas should be created in sequence. Only when the design concept for one is complete can an additional persona be created. This is to avoid the problem of too many personas used at the same time, making the design distractive again.

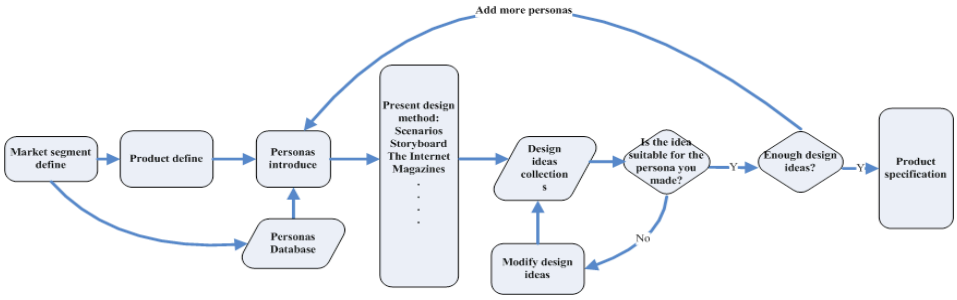


Figure.4: The conceptual model for designers to practise UCD

3.5 The research limitation

There were three design tasks within this research and each task took 10-15 minutes to design. We analysed the difference between the use of personas and the original work. For this research, we can still see a significant difference, even when given a shorter time to complete the tasks. Although in the real world most designers spend more time on concept development, the limitation here is that the longer the time in the experiments, the more difficult it is to find designers to participate in this experiment.

Moreover, the experiment focused on the trend of the UCD approach. Even thought we did not use the Kansai Database to describe the product, we can still observe that the design has been improved after the use of personas. Additionally, this model only evaluated a design for portable devices.

4. Conclusions

4.1 The research conclusions

During this research, we found that present design work tends to fail in relation to UCD. Nevertheless, personas can be used to reinforce UCD and can even mix with present design tools in user research. With the assistance of

the conceptual model based on the use of personas, designers are not only undertaking user-centred design but are also inspired by the personas to create more design ideas. To conclude, this model can help designers integrate their users into their individual design tasks with lower costs.

4.2 The Recommendations

For future studies, below are some suggestions taken from this experiment:

1. A real product can be made from the evaluation model used with the end-users, instead of simply testing with designers.
2. This model only evaluated a product for personal use. To extend the use of the model, a multi-user product, such as a living-room product, can be chosen to enhance the concept.
3. Develop a CAD to assist designers to build their own personas database. This would incorporate random names and photographs, the ability to create multi-persona characters and use tutorials to make the UCD approach much easier.
4. The CAD can be used for the evaluation of the model and can make it easier to collect more respondents.

5. Acknowledgement

I wish to thank the database provider, Face Recognition Technology (FERET).

6. References

[1] Bevan, N and Curson, L. (1999) *Planning and implementing User-centred design*, CHI, 1999, Adjunct proceedings Pittsburgh, ACM Press, New York, VS.

[2] Beyer, H. and Holtzblatt, K. (1998) *Contextual design: Defining Custom-Centered System*, Morgan Kaufmann, San Francisco.

[3] Cooper, A. (1999). *The inmates are running the asylum*. Macmillan.

[4] Dorothy, L. and Rayport, J.F. (1997) *Spark Innovation Through Empathic Design*. Boston: Harvard Business Review Nov-Dec 1997. Reprint #97606, page 107.

[5] Grudin, J. and Pruitt, J. (2002) *Personas, participatory design and product development: an Infrastructure for engagement*. Paper presented at the Participatory Design Conference 2002, Malmo, Sweden.

[6] ISO DIS 13407(1999) *User-centred design process for interactive systems*.

[7] Koskinen, I. (2003) *Empathic Design – Users experience in product design*, IT Press, Finland.

[8] Norman, D. (1988). *The design of everyday things*, Doubleday, New York.

[9] Weitzman, E. A. and Miles, M. B. (1995) *Computer programs for qualitative data analysis*. London, Sage.

Appendix II Research assessment information supplement

Consent form for assessments (Chapter 4, 5 and 8)

PARTICIPANT CONSENT FORM

I, ...[PRINT NAME], give consent to my participation in the research project

TITLE:

In giving my consent I acknowledge that:

1. The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.
2. I have read the Participant Information Statement and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.
3. I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher(s) or the DeMonfort University now or in the future.
4. I understand that my involvement is strictly confidential and no information about me will be used in any way that reveals my identity.
5. I understand that being in this study is completely voluntary – I am not under any obligation to consent.
6. I understand that I can stop the interview at any time if I do not wish to continue, the audio/video recording will be erased and the information provided will not be included in the study.
7. I consent to: –

Video-taping YES ☐ NO ☐

If you answered YES to the “Receiving Feedback Question (iii)”, please provide your details i.e. mailing address, email address.

Signed:

Name: .....

Date: .....

Assessment Design(Chapter 4 and Chapter 5)

The exploration of UCD problems and forming model)

The Plan of the Assessments (Exploration in design practitioners v.s. UCD)

Date	
Participants	NA
Amounts of the participants	30 designers/ design practitioners
The methods in this experiments	Interviews/Questionnaires/Usability

The Plan of the Assessments II (Forming model)

Date	
Participants	Expertise
Amounts of the participants	3-5 senior designers
The methods in this experiments	Interviews/Questionnaires/Usability

Define problems and design experiments

1	Q1: The working experiences in industries --Purposes: 1.To qualitatively know the levels of the difficulties of using Personas in relation to work experiences 2.To qualitatively know the levels of difficulties of experience design in relation to work experiences Question type? Open/Interview --Procedure: a. To ask designers how many years working experiences do they have b. To ask designers what kinds of products have they ever designed? c. The questions are related with Q2.To know the relationship of working experiences and the degree of understanding Personas	
2	Q2: Are the Personas useful? How well do they know Personas? --Purpose: 1.Be a start of the experiments and make every participant to know essential Personas 2.Qualititive survey the status of using Personas in industries -- Question type? Open/Interview	

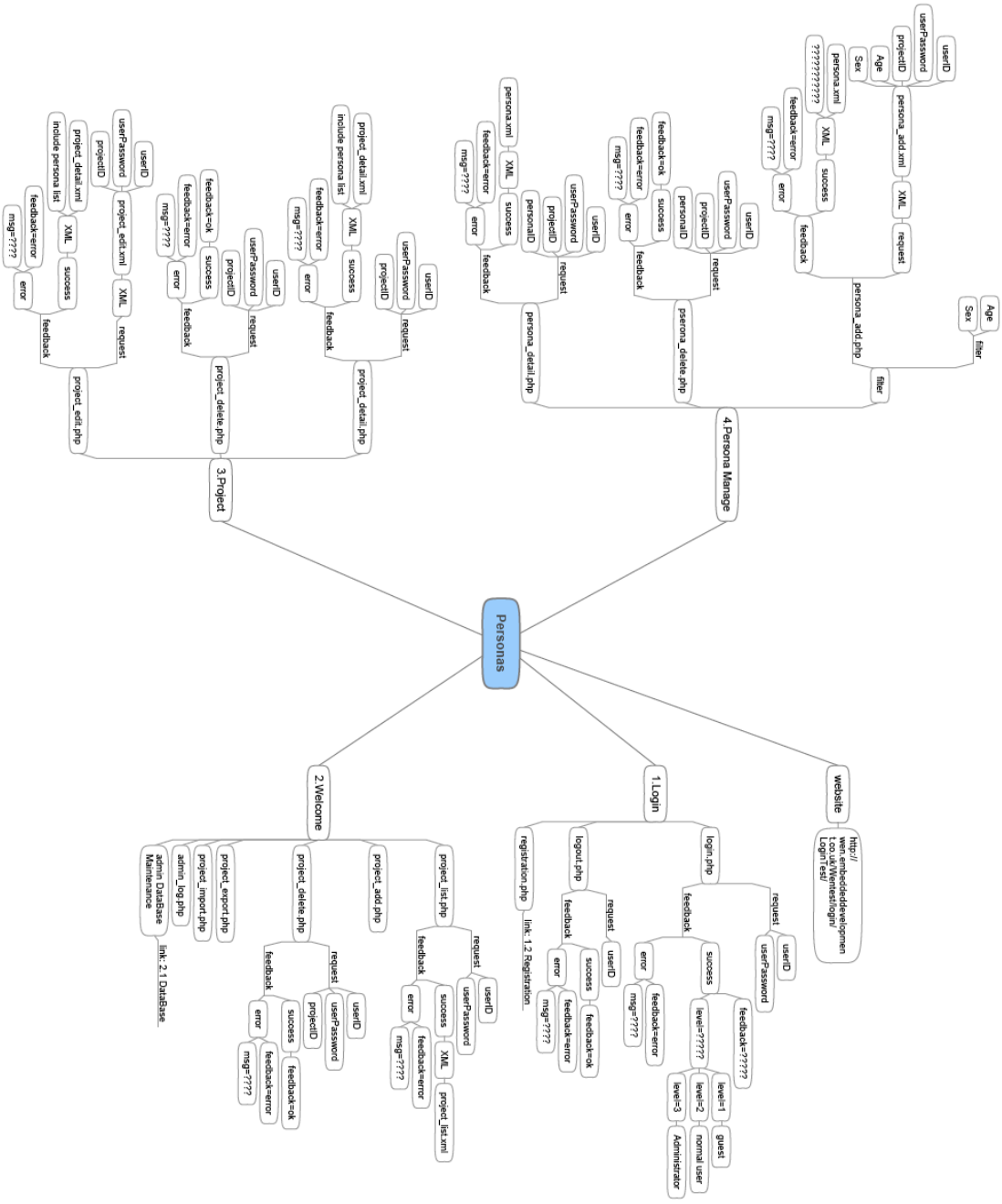
	-- Procedure: a. To ask designers if they have realized the “Power ” of Personas b. If yes, how powerful do they feel?(In what aspects do participants feel that Personas do help?). go to “d.” c If no, to introduce personas (3-min, prepare appropriate materials) and repeat a d. Task done.	
3	Q3: Create a set of customer data. Give it to independent teams and ask them to create personas. Do they arrive at similar results? --Purpose: 1.This is the open question from the paper which is mentioned in 4.3.1 2.To know	
4	Q4: Give an assignment of designing a product which needs to be designed with appearances and functions.(Prefer mobile electric devices) by using Personas. A particular Persona will be given. --Purpose:	

Interaction with Personas (Chapter 4) :

More idea when using personas	Can you image Jenifer is smile in our mind who interacts with your product?	more focus with persona
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	No	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	No	No
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
No, it is the same as last topic I design	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
No, it is the same as last topic I design	No	No
Yes, I can get more ideas from the information	Yes	No
Yes, I can get more ideas from the information	No	Yes
Yes, I can get more ideas from the information	Yes	No
No, it is the same as last topic I design	No	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
No, it is the same as last topic I design	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Others:	No	No
No, it is the same as last topic I design	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Others:	Yes	No
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Others:	No	No
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes

Yes, I can get more ideas from the information	Yes	Yes
No, it is the same as last topic I design	Yes	No
No, it is the same as last topic I design	Yes	No
Yes, I can get more ideas from the information	No	No
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Others:	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes
Yes, I can get more ideas from the information	Yes	Yes

Personas interface plan: Mindmap: Chapter 6



Persona interface code in xml (partial)/(Chapter 6)

Photo Uploader

```
  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
<title>UserInput</title>

</head>

<body>
<div align="center">
  <p align="left">This is a photo uploader fo the personas project.Please upload the photo with detailed information provided.</p>
  <p align="left"> </p>
</div>
<form action="add_PhotoUploader.php" method="post" enctype="multipart/form-data" name="form1" target="_self" id="form1">
  <p align="left">Step1:Select the location of the photo.</p>
  <p align="left">Find Photos
    <input name="Findfile" type="file" id="Findfile" size="50" />
  </p>
  <p align="left">Step2:</p>
  <p align="left">Provide the information of the persona:</p>
  <p align="left">Gender
    <select name="Gender" id="bGender">
      <option value="1" selected="selected">Female</option>
      <option value="2">Male</option>
    </select>
  </p>
  <p align="left">Age
    <input name="Age" type="text" id="Age" size="5" />
    (16-80)</p>
  <div align="left">Race
    <input name="Race" type="text" id="Race" size="30" />
    *If you know </div>
  <p align="left">File Size Format (WidthxLength)</p>
  <p align="left">
    <label>
    <input type="radio" name="FileSize" id="filesize" value="1" />
      640x480 </label>
    pix </p>
  <p align="left">
    <input type="radio" name="FileSize" id="filesize" value="2" />
    480x640 pix</p>
  <p align="left">
    <input type="radio" name="FileSize" id="filesize" value="4" />
    800x600 pix</p>
  <p align="left">
    <input type="radio" name="FileSize" id="filesize" value="8" />
    600x800 pix</p>
  <label></label>
  <p>
    <label>
    <input type="submit" name="photoUpload" id="photoUpload" value="Submit" />
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  </p>
  <p></p>
</form>
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Interface to PHP and Flash (1)

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The Proposal of the CAD usability Test (Chapter 7)

Aim

To test the usability of the personas usability for improvement

Objectives

- Define the users
- Define the usability goals and tasks
- Define the questions
- Trial test (to validate the questions) by card sorting
- To do the usability of persona CAD operation

Experiment design

- Define the users (experienced user, beginner, no experience.)
- Personas experiences (used, or learned): Designers who are with less design experiences
- Designers who are senior
- Further define (product design, web design)

Define the usability goals and tasks

CAD Goal:

To be able to assist designers creating personas and hence help in idea generations.

Tasks:

- Administration task (log in/log out and register)
- Project management
- Create a persona in a project
- Create multiple personas in a project
- Idea generation
- Help/training file accessibility

Participants: 15 people who used personas in their product design

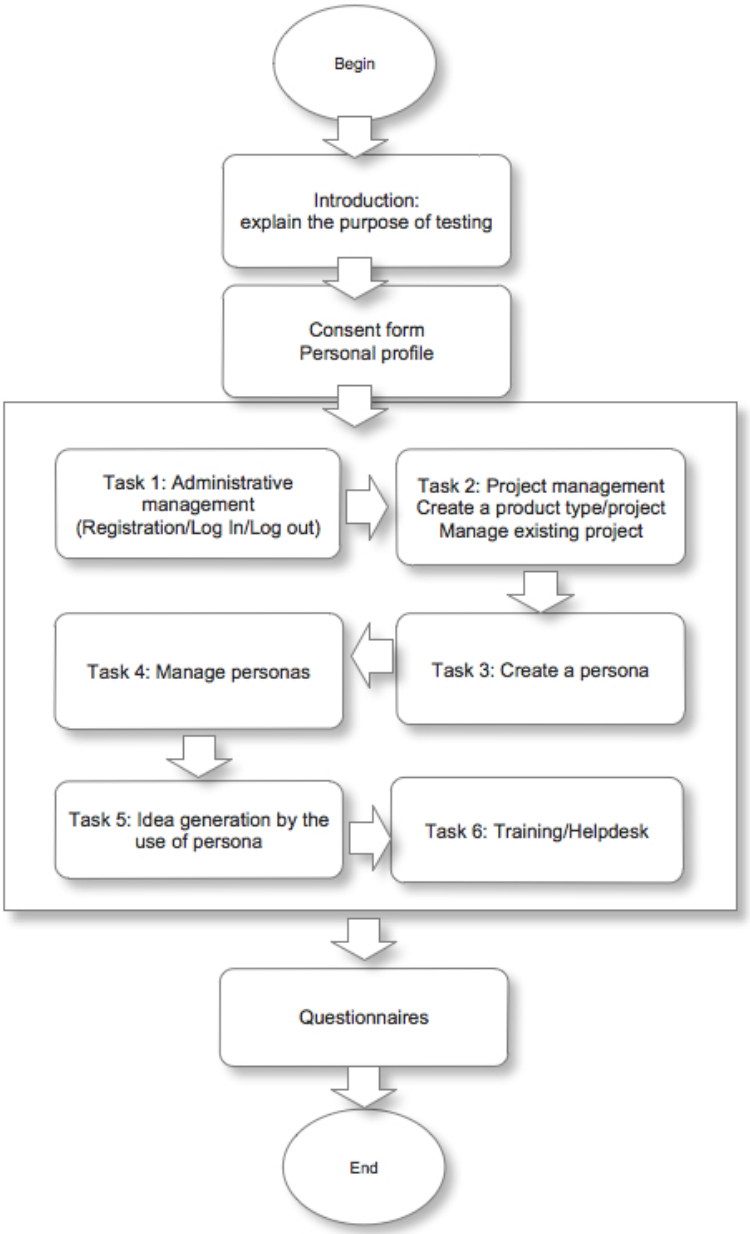
Target: to validate the context design for persona CAD

Methods: card sorting with tasks listed in 3.2 to see if the pattern of the CAD

And videotape will be used to facilitate the data analysis.

Time: each participant will use 5 minute to explain the scenarios as well as the ethic issues, 10 minutes to organize the order of cards, and 10 minute to fill the questionnaires (25 mins each)

Procedure


Begin
Introduction:
explain the purpose of testing
Consent form
Personal profile
Task 1: Administrative management (Registration/Log In/Log out)
Task 2: Project management
Create a product type/project
Manage existing project
Task 3: Create a persona
Task 4: Manage personas
Task 5: Idea generation by the use of persona
Task 6: Training/Helpdesk
Questionnaires
End

Prior Questionnaire

Please do the consent form to agree this test

Topic/ purpose explanation.

Personal profiles:

Male ☐ Female ☐

Age ____

Highest Education _____

Design experience: ☐ experienced designers

☐ junior designers

☐ design students

What are the projects of product design you have involved or you have ever designed? _____

Knowledge of personas

☐ 1.I knew personas, but never used them

☐ 2.I knew how to use it, but never use them.

☐ 3.I knew personas, and I use them a lot

☐ 4.I don't know personas

☐ 5.Others, please illustrate :_____

If you answer is 1 to 3 above, can you write down what is the definition of personas?_____

_____

If you used personas before, can you tell me where do you acquire the personas? ? _____

_____

Do you know how to create a persona? Describe it

Do you use computer a lot? (Do you find it is difficult to go to mydmu to see your profile)

Card sorting job start.（Provide the elements and to see if they can assemble the order of them)

- **After Questionnaire**

- If the personas CAD made by the functions we have done, how do you feel about this personas CAD design?

  Dissatisfied □ a bit dissatisfied □ nurture □ excited □ very excited

  Explain the reasons why you are dissatisfied with the persona CAD

  _____

  _____

  How you like the Style and color scheme?

  1.Style

  Dissatisfied □ a bit dissatisfied □ nurture □ excited □ very excited

  2.Color Scheme

  Dissatisfied □ a bit dissatisfied □ nurture □ excited □ very excited

- If there is a CAD designed by the concept we discussed, are you willing to use it in design?

  □Yes, very happy to use □ Yes, maybe I will use □Don't know yet □ No,

  I think I may not use □ I definitely will not use.

  Will you tell us what is your concern for not using this persona CAD in

  your design?_____

  - Which benefits are likely from using this personas CAD in your design?(can be multiple chosen)
    □time saving □ no need for too complicate skills to use personas □ more concentrated to target users □ others

    _____

  - Do you have any suggestions to this CAD development?

    _____

    _____

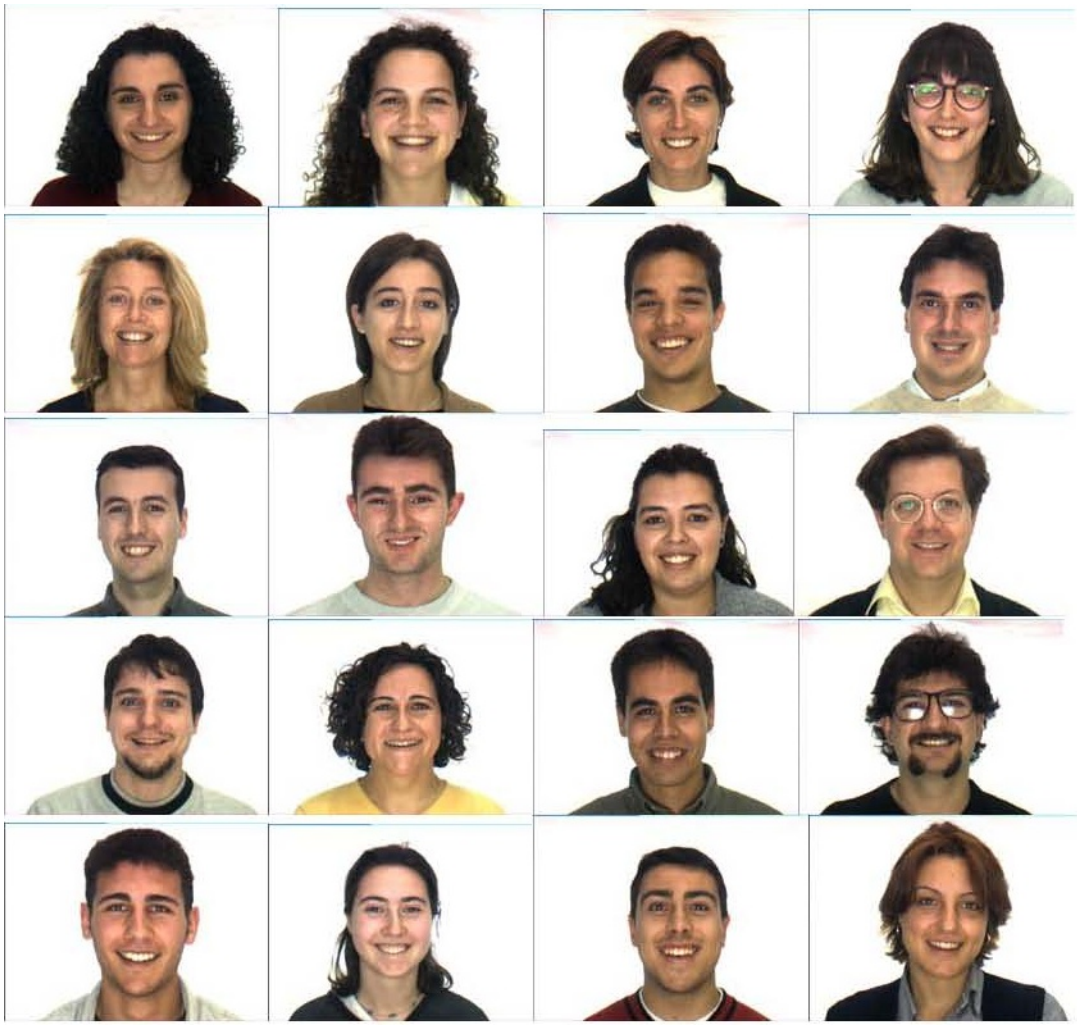
    Thank your for your kindly assist in this assessment, your involvement makes this research more complete and successful.

Wen Nivala

PHD Researcher

Art & Design

shw.dmu@gmail.com



Appendix III HREC Approval FORM

Faculty of Art and Design

Research Proposal Form

Student/Researcher Name

Cing-Yan Hsu

Title of Research Project

The development of a model using empathic design technique as the basis for user-centred design

Statement of Research Objectives

The research objectives of the investigation are to develop a theoretical model based on empathic design process in order to support designers for product definition and specification more systematically. An integrated computer-aided tool will also be innovated for the purpose of evaluation of the model.

Rationale for Undertaking the Study

There are an astonishing number of everyday things that fulfil our daily life and as has been pointed out by Norman (1986), poorly designed objects can be difficult and frustrating to use. To cope with this, a design philosophy is promoted, called user-centred design (UCD). UCD means the design is based on the needs of users (Norman, 1986). Several methods can be used to approach UCD; one of them is participatory design, which involves users in whole design process. An alternative technique is empathic design, which in contrast, approaches UCD by designing product empathically. To achieve empathic design, products must be developed with taking users' needs into consideration (Koskinen, 1994). Companies such as Apple, Motorola and Microsoft have already integrated anthropologists into their personnel to observe users' daily activities (Beyer, 1998). Contextual inquiry, scenarios and personas are therefore now widely used so that designers can better incorporate user requirements. Unfortunately, gathering consumers' needs is costly and would be rarely used by those enterprises that only have a limited budget (Grudin, 2002). Even a well-known tool called Quality Function Deployment (QFD) is a popular way to transfer user needs to real specifications, there is still a large gap between users' needs and actual specification. Because of this, an economical and integrated method based on empathic design is needed to support design works.

Statement on Research Procedures and Methodologies

The proposed objectives and related methods of this research are:

1. Secondary Studies

1.1 To do literature review to find out target research area (Keyword: User centred, Empathic Design, User research, Quality Function Deployment).

1.2 To do literature review to identify and define problems. (To analyze the weakness and the strength of previous works in user research and to find out the problems).

1.3 To do literature review and define primary studies.

After stage 1.3, the transfer is anticipated.

2. Primary studies

2.1 To propose an empathic design model from interview to design expertises.

2.2 Develop a computer -aid tool by user-centred design process, which will follow the standard ISO13407.

2.2.1 User analysis for tool development by using personas/scenarios/contextual inquiry (interviews).

2.2.2 Use QFD (Quality Function Deployment) to transfer customer requirement into quantitative product specification. (Quality Function House will be used).

2.2.3 Select a specific product to apply database for tool evaluation.

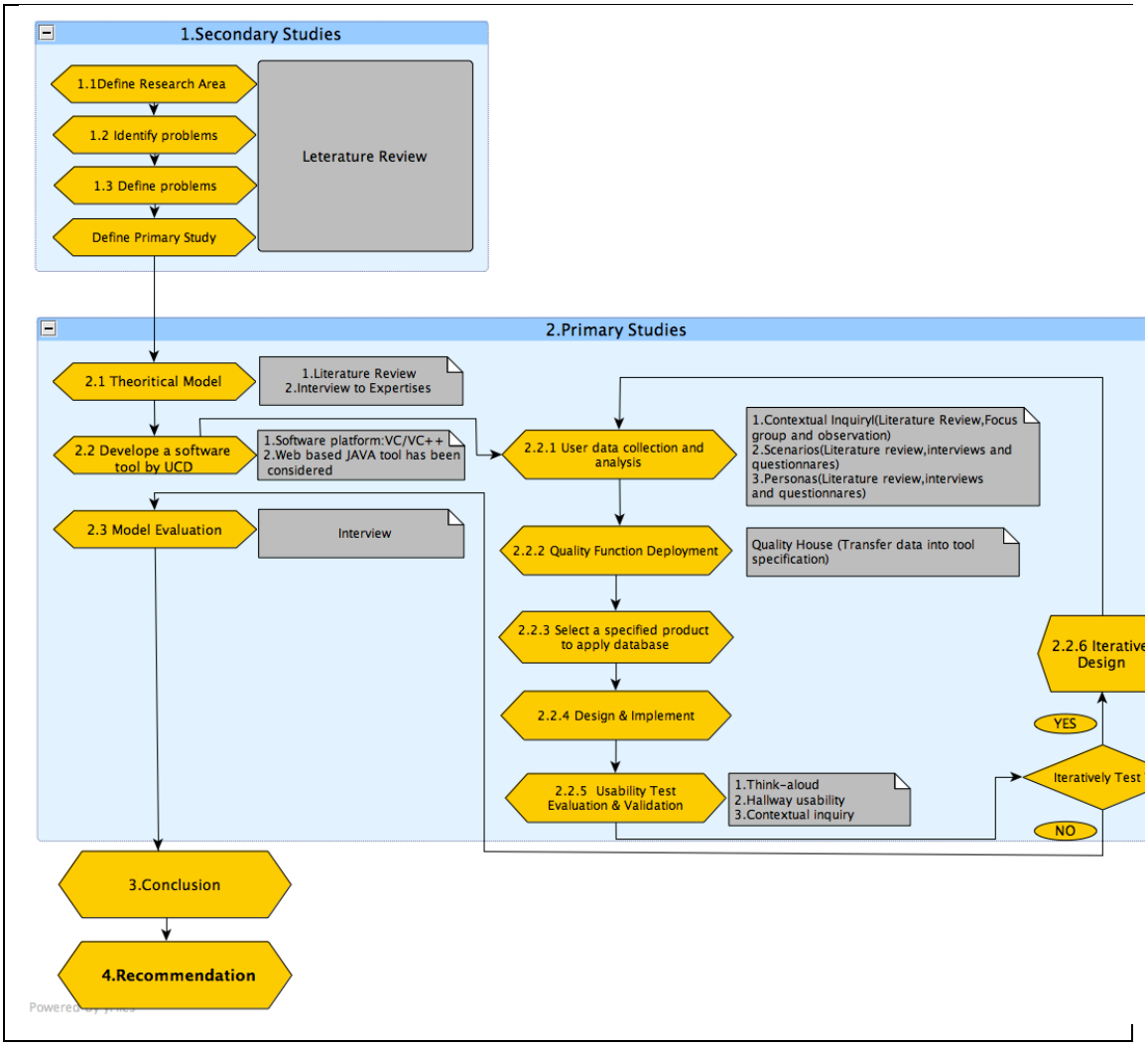
2.2.4 Design a computer-aid tool to help designers to define product specification that is much closer to customer's requirements based on the proposed model. Development platform (VC++, JAVA or similar platform).

2.2.5 To do usability testing by using methods such as think-aloud protocol, hallway usability testing and contextual inquiry.

2.2.6 Modify the tool iteratively based on user centred design process.

2.3 Evaluate the empathic design model by the software tool (interviews).

3. Make conclusions and recommendations.



Full details of arrangements for participation of human subjects, including recruitment, consent and confidentiality procedures and documentation

The ethic related objects in this research are conducted only in specified stages of primary studies that are listed as follows:

2.1 To propose an empathic design model from interview to design expertises.

2.2.1 User analysis for tool development by using personas/scenarios/contextual inquiry (interviews). The interview skills aim to collect expertise data in manipulating user research from senior designers.

2.2.5 To do usability testing by using methods such as think-aloud protocol, hallway usability testing and contextual inquiry.

2.3 Evaluate the empathic design model by the software tool (interviews).

The model evaluation aim to hire some interviews to measure the emotional

satisfaction and usability.

More detailed scenarios are described as follows:

2.1 In this section, to interview to design expertises will be applied.2~3 interviewees will be needed. To interview with them will get the present design status, experiences and requirements.

2.2.1 User data collection and analysis is the beginning of user-centred design process. In order to make a tool followed user-centred design; to collect users' needs is compulsory. Thus the interview method will be used before the implementation of the computer aided-tool. This stage will be combined with 2.1 to interview designers for getting their requirement.

2.2.5 Usability Test

Usability test is a common evaluation method when an interactive product is generated. Think-aloud protocol, hallway usability testing and contextual inquiry will be applied.

2.4 To evaluate the empathic design model

The computer-aided tool can support the evaluation of the model. In this stage, the interview method will be applied to experienced designers.

All data related to the ethic issues will be strictly followed the rules which have reminded by Human Research Ethics Committee. The detail of the ethic processes in this research are summarised in here:

1. A consent form will be used to inform the participants before the testing which is in the attached file.
2. Clear introduction will be made to reveal the purposes, procedures of the experiment before it has been conducted.
3. To clear inform the participants their rights such as withdrawal or discontinue the test in any time
4. The data will be carefully kept in the laptop with proper password protected. The data will be destroyed after the research or at anytime by the participant's demand.
5. To acquire the receipt of participant's agreement in every test as the information of the research.

Details of intentions in respect of the publication of findings

The intentions in respect of the publication of findings are as follow:

1.Conferences and Journal paper to reveal the research outcomes.

2.A thesis to complete the PHD degree.

Details regarding the storing or disposal of data on identifiable individuals after completion of the study

The disposal data will be confirmed to destroy whatever materials in papers or electronic document.

Assessment of risks and benefits, if applicable

Student Name

Cing-Yan Hsu/Wen Nivala

Title of Research Project

The development of a model using empathic design technique as the basis for user-centred design

HRE Issues Checklist (for completion by supervisor)

1. Has the research proposal identified any of the following research procedures? (circle):

Gathering information about human beings (and organisations) through;

- Interviewing
- Surveying
- Questionnaires
- Observation of human behaviour
- Taking Photographs
- Body measurements
- Interfering in normal physiological and/or psychological processes

2. Using archived data in which individuals are identifiable

3. Researching into illegal activities

If any of the above are circled, does the proposal satisfactorily identify the ways in which the student will be dealing with the following (tick boxes for "Yes"):

Voluntary participation without inducement and procedures for gaining written consent (consent forms seen by supervisor and accepted);

Procedures for providing participants with full awareness of the objectives of the research, the procedures to be followed, and the anticipated outcomes particularly in respect of publication of findings;

Provision for all participants of a written description of their involvement in the project, the demands to be made, their rights and how their rights and interests will be protected, particularly in respect of confidentiality, privacy and safety;

Information given to participants making them aware of their freedom to withdraw consent and discontinue participation at any time;

Establishment of procedures for keeping appropriate records;

Proforma for participant to sign acknowledging receipt of the information materials pertaining to the project's objectives and intended outcomes.

Do the procedures identified in the proposal necessitate formal risk assessment? YES/NO
Has the risk assessment been carried out? YES/NO

Signature of Student/Researcher: Date:

Signature of Supervisor: Date:

Confirmation of Approval by Faculty Human Research Ethics Committee

Signature of Chair: Date:

The Consent letter and Ethic Acknowledgement for the Participants

This letter is to inform that the experiment will strictly follow the ethic claim, which intends to protect the participant:

1. To ensure the participant will understand the purposes and procedure of the experiments before it commences, an oral introduction will be given.

2. Participation in this research is entirely voluntary. The information of the test such as period of the experiment, test date and test place will be prompted before the test.

3. The participant can withdraw or discontinue the experiment at any time. On the other words, the participant always has right to decide not to answer during the test.

4. The information that is provided by the participant is confidential, except your permission anonymised quotes may be used. The information will be safely managed, and destroyed by participant's request or after the use of the research. The period of keeping the data is from _____to _____

5. Participants can request not to appear any personal information such as the name.

6. The researcher's contact information is provided as follow in case of the participant's request.

Researcher: Cing- Yan Hsu
TEL (+44)7958722226
Email:shw.dmu@googlemail.com

I do voluntarily participate this research, and totally understand my right and the purpose and the procedure of the test. I, therefore, sign this letter for acknowledgement.

Name:

Signature:

Date: